WATER & SEWAGE WORKS

WATER SUPPLY • SEWAGE DISPOSAL

UNIVERSITY MICROFILMS
313 N. 1ST ST.
ANN ARBOR, MICH.
COMP

APRIL 195

...go's Famed Michigan Boulevard Adorned With 24-inch C.I. Pipes
See page 141

Uranium Boom-Town, Farmington, N. Mex., Gets a Water Treatment Plant

Abandoned Coal Strip Mine Cuts Used as Final Sewage Settling Units

VALVE OPENING *equals* PIPE OPENING

4" valve ... port area— 12.75 sq. in.

4" pipe ... area— 12.73 sq. in.

That's the formula of success behind **acf** Rectangular Port Valves! Because they have a port area at least equal to the pipe itself... turbulence and loss of head pressure are held to a minimum... even when handling heavy slurries and other viscous ladings.

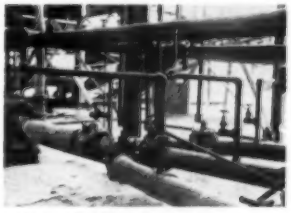
All **acf** *Cylindrical* Lubricated Plug Valves .. both those with rectangular and round port openings ... feature split-second, quarter-turn shut off that meets the rigid control requirements in the petroleum, natural gas, and processing industries. Maintenance is especially low because they are fitted with TEFLON* gaskets to prevent head leakage, and have no line seats exposed to fluid flow.

ACT NOW TO KEEP DOWN VALVE MAINTENANCE COSTS!

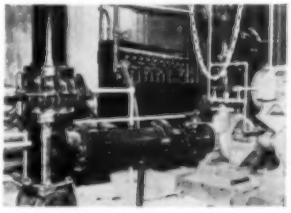
Representatives in 50 Principal Cities. Write for Descriptive Catalog 5-G, **acf** Industries, Incorporated, Valve Division, 1501 E. Ferry Avenue, Detroit 11, Mich.

*DuPont Tradename

On Petroleum Applications



In Chemical Plants

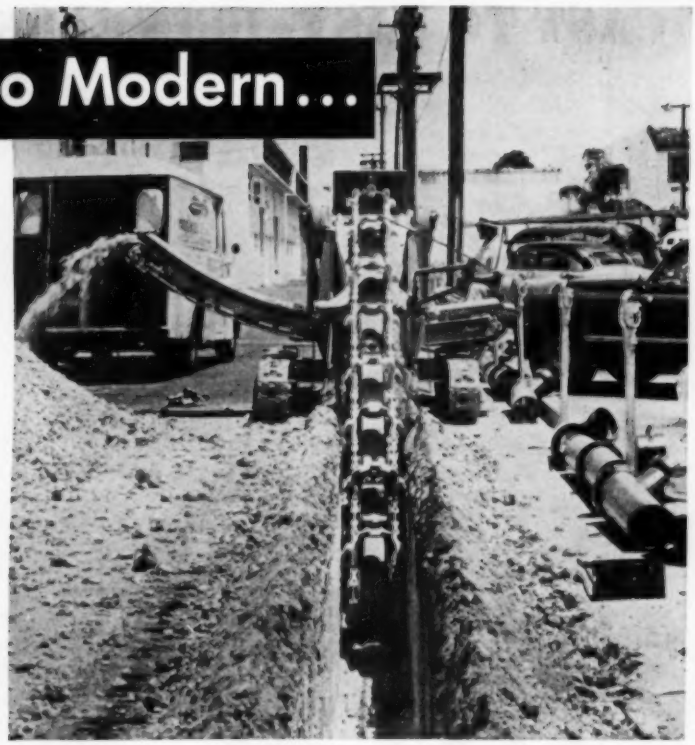


In Sewage Treatment

acf CYLINDRICAL FULL PIPE AREA **PLUG VALVES**

When Cities Go Modern...

CLAY PIPE SEWERS GO IN



CORAL GABLES, FLORIDA, had a population of only 8,300 people in 1940. Today, the population has zoomed to more than 30,000—and public health facilities are being modernized to meet this amazing growth. A 259,000-foot bond-financed sewerage system, costing $3,372,000, is being installed.

Vitrified Clay Pipe is the safe choice of city officials, because it's sure to give dependable, trouble-free service long after the bonds are retired.

Clay Pipe is not only the *safe* material, but the practical material for municipal sewerage. A wide variety of new jointing methods and materials, developed through Clay Pipe research, insure a system that holds infiltration to a minimum, even in Florida's high-water-table areas. And Clay Pipe is the economical material, because its cost-per-year-of-service is the lowest. Where public health is at stake, why take chances on substitutes? Specify and install Vitrified Clay Pipe . . . guaranteed for 50 years.

FOR CORAL GABLES, FLA.—W. T. McIlwain, City Manager
CONSULTING ENGINEERS—Smith and Gillespie, Jacksonville, Fla.
M. B. Garris and Associates, Coral Gables, Fla.

Vitrified CLAY PIPE NEVER WEARS OUT!

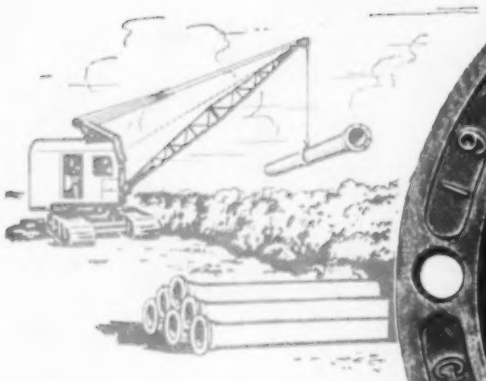
NATIONAL CLAY PIPE MANUFACTURERS, INC.
1820 N. Street, N.W., Washington 6, D. C.

206 Connally Bldg., Atlanta 3, Ga.
100 N. LaSalle St., Rm. 2100, Chicago 2, Ill.
703 Ninth & Hill Bldg., Los Angeles 15, Calif.
311 High Long Bldg., 5 E. Long St., Columbus 15, Ohio

C-256-1

Progress in Public Health - Through Clay Pipe Research

CAST TO LAST–100 YEARS



let's face it!

CLOW CAST IRON PIPE MEETS ALL REQUIREMENTS

When you lay pipe underground it must be strong . . . tough . . . uniform . . . and durable.

Before specifying pipe for your system, consider these 10 fundamental requirements for any underground pipe for water service.

Clow Cast Iron Pipe meets them all!

LONG LIFE—proved to be 100 years and more
BURSTING STRENGTH—for working pressure plus water hammer
TOUGHNESS—to resist shock and impact
TENSILE STRENGTH—to withstand high bursting pressure
BEAM STRENGTH—to withstand trench and traffic loads
COMPRESSIVE STRENGTH—to resist crushing loads
IMPERVIOUSNESS—no leakage, seepage or sweating
TIGHT JOINTS—of proved dependability
TAPPING STRENGTH—for strong, clean threads
FLOW CAPACITY—large, smooth bore for maximum flow

SINCE 1878

JAMES B. CLOW & SONS, Inc.

201-299 North Talman Avenue, Chicago 80, Illinois

Subsidiaries:
Eddy Valve Company, Waterford, New York
Iowa Valve Company, Oskaloosa, Iowa

WATER & SEWAGE WORKS

WATER SUPPLY • SEWAGE DISPOSAL

COMING ARTICLES

Revitalizing St. Louis' Water Supply Arteries ..... *Serkes*
St. Louis County Water Company Expands ..... *Dolson*
Bentonite Clay Improves Filter Performance at Gary, Ind. ..... *Louis*
Cutting Large Diameter Cast-Iron Pipe Economically ..... *Hennings*
Digester-Gas Engine Operation & Maintenance Experiences ..... *Kass & Lino*
A "Kink" in Fire Hydrant Replacement ..... *Winter*
"Total Oxidation": A Method of Sewage Treatment ..... *Kountz*
Sewage Flow Control Through Automatic Multi-Speed Pumping ..... *Meeker*
Centrifugal Pumps: Design, Operation & Maintenance ..... *Carter & Karassik*
Sewage Works Operation (A Continuing Series) ..... *Jaffe*
Water Works Practices (A Continuing Series) ..... *Symons*

E. SCRANTON GILLETTE
Publisher

•

LINN HARRISON ENSLOW
Editor

•

HERBERT P. ORLAND
Associate Editor

Assistant Editor, F. C. MAURER
Make-Up Editor, Mrs. A. H. SKATES
Feature Writer,
GEORGE E. SYMONS, Ph.D.

•

Editorial Associates
A M RAWN J. R. BAYLIS C. E. KEEFER
L. L. HEDGEPETH

•

EXECUTIVE OFFICE

185 North Wabash Ave., Chicago 1, Ill.
E. S. Gillette, *President & Publisher*
H. J. Conway, *Sec.-Treas. & Adv. Dir.*

EDITORIAL OFFICES

155 East 44th Street, New York 17, N. Y.
Linn H. Enslow, *Vice-Pres. & Editor*
F. C. Maurer, *Assistant Editor*
310 W. Church St., Champaign, Ill.
Herbert P. Orland, *Associate Editor*
Mrs. A. H. Skates, *Make-Up Editor*

BUSINESS OFFICES

Chicago: 185 North Wabash Ave.
Terence McCoy, *Western Mgr.*

New York: 155 East 44th Street
Evans J. Kall, *Eastern Mgr.*
William R. Joyce, *Cent. Dist. Mgr.*
Hale H. Carey, *Sales Rep.*

West Coast: 1709 W. 8 St., Los Angeles
Don Harway & Co., *Rep.*

Copyright 1956 By Scranton Publishing Co.

Vol. 103 **APRIL 1956** **No. 4**

Another Link in Chicago's Water Works Improvements 141
by Dewey W. Johnson

AWWA's Diamond Jubilee Convention Technical Program 144

Introduction to Basic Radiological Health for Water Works Personnel 145
by David H. Howells

Filtration — Part 2 (29th of a Series) 151
by G. E. Symons

Uranium Boom-Town Gets a Water Plant 158
by John Seagraves

New Rate Controller for Water Filter Plants 160
by E. Frank Stover

Pump Motor Starting Problems 163
by M. C. Boggis and E. O. Potthoff

Lubrication of Equipment for Water and Sewage Works 171
by Edw. A. Tschida

Requirements for Establishing Industrial Waste Ordinances 173
by Dean M. Taylor

Abandoned Strip Mine Cuts Used as Final Settling Units 177
by Eugene Jacoby

How About Sewage Works Safety? (Dear Bill Letter) 180

Meetings Scheduled 77A

New Equipment 88A

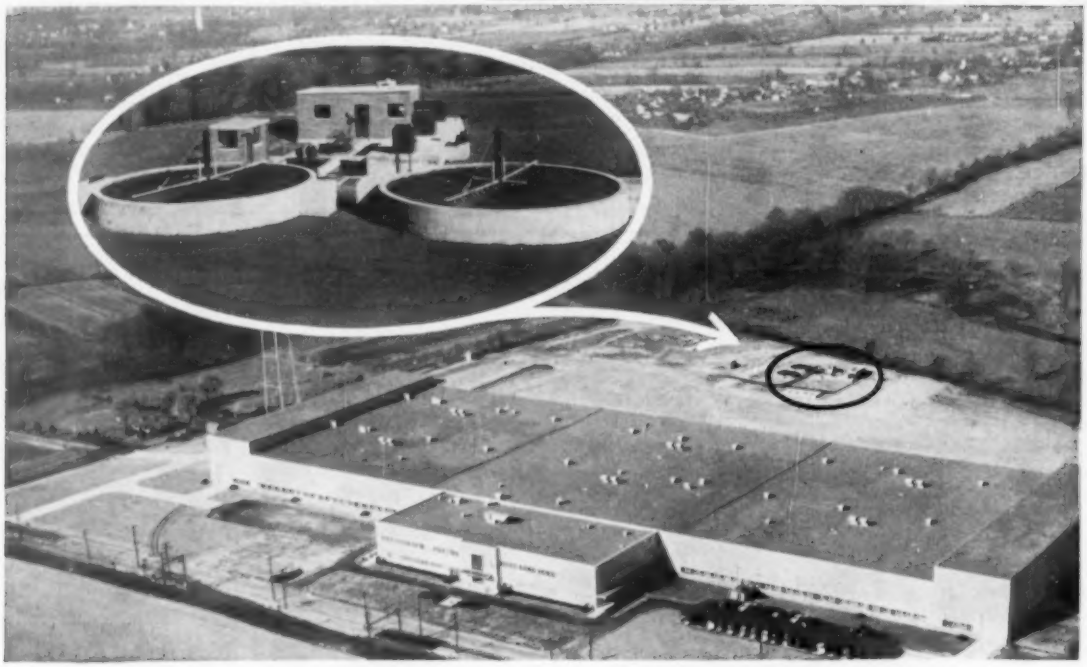
Manufacturers' News 99A

Literature and Catalogs 104A

WATER AND SEWAGE WORKS is published monthly with an extra issue in June. Subscriptions including the Reference and Data issue in the U. S. and Canada, 1 year $3.00; 2 years $4.50; 3 years $6.00. Other countries $1.50 per year additional. Single copies 25¢ except Reference and Data issue 50¢.

WATER AND SEWAGE WORKS, Reg. U. S. Patent Off. Published monthly by Scranton Publishing Co., at 5th and Ferry St., Lafayette, Ind. Entered as second class matter at the post office at Lafayette, Ind., under Act of March 3, 1879.

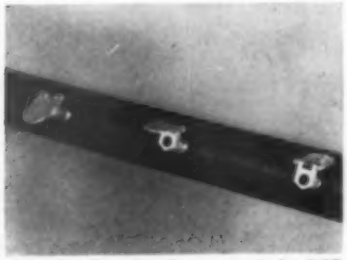
Link-Belt sewage treatment plant (inset) with PFT Rotary Distributors on 25′ filter beds.



Link-Belt chooses PFT Rotary Distributors for its own sewage treatment plant

As an important manufacturer of waste treatment equipment, the Link-Belt Company quite naturally drew upon its own fine equipment in adding sewage treatment facilities to its great modern plant in Colmar, Pa.

PFT is proud that its *Rotary Distributors* were selected for the two 25′ diameter filter beds. Working in conjunction with Link-Belt's own equipment, these Distributors have proved their efficiency in a thoroughly modern installation.



Spreader Jets for the arms of the PFT Rotary Distributor. Note various positions of the hinged deflectors which raise or lower to accommodate desired flow.

The sewage plant handles the domestic wastes of some 650 employees in addition to all the industrial wastes that respond to trickling filter treatment.

Each Distributor is designed to handle 180 g.p.m. of settled sewage. Pumped directly to the rugged center column, the sewage is then distributed through 3" diameter arms of galvanized steel. PFT Spreader Jets are carefully spaced along the arms for uniform distribution over the entire filter bed area.

A unique feature of the Spreader Jet is the hinged deflector. This design was originated by PFT and is particularly adaptable to small distributors. By hinging above the orifice (see illustration), the deflector lifts under initial head and permits maximum reactive force to bring the Distributor up to the proper rotational speed.

As the head drops to normal operating pressure, the deflector drops to a position that produces a flat, uniform spray with even distribution over the filter bed.

The circular orifices in the Spreader Jets are always open to full size. This practical design effectively reduces clogging and simplifies maintenance.

Design of plant by / Link-Belt Company Engineering Dept.

waste treatment equipment
exclusively since 1893

P.F.T.

PACIFIC FLUSH TANK CO.
4241 Ravenswood Avenue
Chicago 13, Illinois

PORT CHESTER, N. Y. • SAN MATEO, CALIF. • CHARLOTTE, N. C. • JACKSONVILLE • DENVER

Cut your big jobs down to size —with the Powerful Oliver OC-12

The versatile OC-12 works with any mounted equipment you require: 1¼-yd. loader, bulldozer, side boom, winch. Choice of two gauge widths: 44" and 60" and two track lengths.

Here's a big package of tractor power in a handy, compact size for all those digging, dozing, loading and backfilling jobs. Designed into the modern lines of the Oliver OC-12 are more tractor advancements than any other in its power class. They all add up to the ability to do more jobs in faster time and at lower costs.

You have a choice of two engines with the OC-12—diesel or gasoline of 53 drawbar h.p. with each featuring exceptional torque characteristics. Built for tractor service, these power plants require far less attention. You get fast, easy starts, pressure cooling, by-pass thermostat, full-flow oil system and numerous other quality features.

The OC-12 has job-easing controls with steering which keeps power on both tracks at all times. Deep mud, tough terrain, hard work, close quarters—do not stop the OC-12.

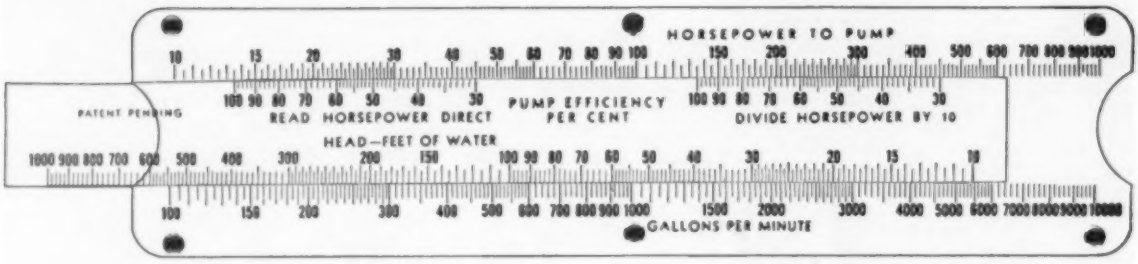
See how the Oliver OC-12 can be your wisest tractor investment—talk to your Oliver Industrial distributor. Try the OC-12 yourself.

THE OLIVER CORPORATION
400 West Madison Street, Chicago 6, Illinois

OLIVER

a complete line of industrial wheel and crawler tractors and matched allied equipment

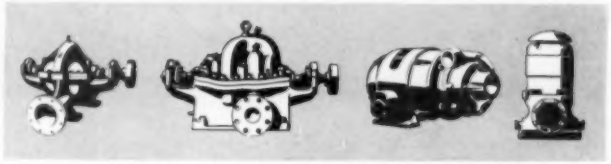
Reserved for you—Mr. Engineer...



THE NEW PEERLESS HYDRAULIC SLIDE RULE

Yes sir, Peerless pump has reserved a new Peerless hydraulic slide for you. This slide rule solves common water problems. Head, capacity, horsepower and efficiency all appear on one setting. Saves time in sizing and selecting pumps for all your pumping problems.

The quantity is limited. So act now. Mail the coupon below today!



HORIZONTAL PUMPS **VERTICAL**

Type A—For the widest variety of pumping conditions. Capacities up to 70,000 gpm. Heads to 300 ft. All types of drive.

Type TU—2, 3, 4 and 5-stage high pressure pumps for water and other liquids. Capacities: 50 to 3500 gpm. Heads up to 1600 ft.

Type PE — General purpose pump for clear liquids. Motors ½ to 150 hp. Face-mount and flexible-coupled elec. drives.

WATER SUPPLY — and liquid transfer service. Heads to 1000 ft. Capacities up to 50,000 gpm. Drives up to 2500 hp.

PEERLESS PUMP DIVISION
FOOD MACHINERY & CHEMICAL CORPORATION
2005 NORTHWESTERN AVE., INDIANAPOLIS 8, INDIANA

PEERLESS PUMPS fmc

Factories: Los Angeles 31, California and Indianapolis 8, Indiana
Offices: New York; Atlanta; Chicago; St. Louis; Phoenix; Fresno; Los Angeles; Plainview and Lubbock, Texas; Albuquerque.
Distributors in Principal Cities. Consult your Telephone Directory.

☐ *Please send me a Peerless Hydraulic Slide Rule* ☐ *Please have a Peerless sales engineer call*

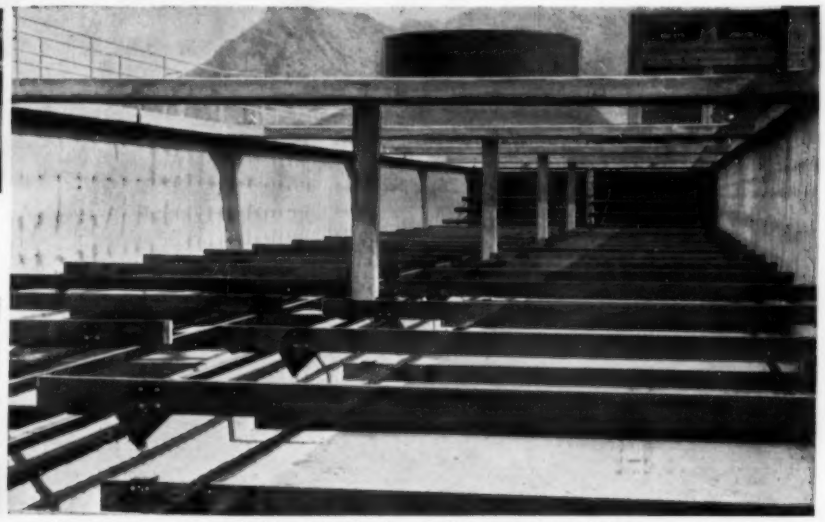
NAME_____ COMPANY_____

ADDRESS_____ CITY_____ STATE_____ WSW

Visit our exhibit . . . A.W.W. A. Convention, St. Louis, May 6-10

CIRCULINE COLLECTORS for square or round tanks provide quick, positive removal of sludge and dense sludge with lowest possible water content.

TRASH SCREENS are operated intermittently, and remove large floating debris to protect water screens and other equipment from damage.



Population expansion called for 30-mgd addition to treatment facilities at this plant. By adding Link-Belt chemical mixing and flocculation equipment, system can now handle 40 mgd in emergencies. And from a master plan projected to year 2000, further extensions and increased capacity can be accomplished with minimum changeover.

Plan for the years ahead

with LINK-BELT water treatment equipment

FLASH MIXERS continuously, rapidly and thoroughly mix chemicals prior to flocculation . . . prepare chemicals and water for immediate flocculation.

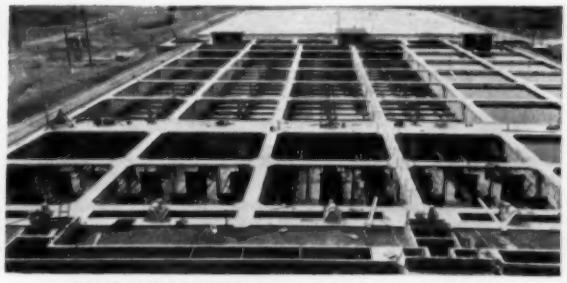
TODAY, more and more water purification systems are being built with consideration for future as well as present needs. Hence, dependability of equipment takes on added importance in reducing chemical and operational costs and more efficient operation. And Link-Belt is helping to meet these requirements—offering a broad range of long-life equipment that permits expansion of capacity with a minimum of changeover.

Our sanitary engineers will work with your own engineers, chemists and consultants. For further details, call your nearest Link-Belt office.

LINK-BELT

SANITARY ENGINEERING EQUIPMENT

SCREW CONVEYORS AND BUCKET ELEVATORS efficiently handle chemicals. This system in chemical building distributes lime or alum to storage bins.



STRAIGHTLINE MIXERS are used in flocculation tanks (foreground), while Straightline sludge collectors and cross collectors are installed in settling tanks.

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.

14,083

IT KEEPS YOU
but for a

MODERNIZED cast iron

AWAKE, TOO... different reason

To the householder, a dripping faucet is only an annoyance . . .

To you it's waste that can be eliminated only by an educated and alert public, willing to cooperate in your efforts at conservation.

Here, we can . . . and will continue to . . . help.

Our national advertising campaign, reaching millions, stresses conservation and the need of long-range, advance planning for adequate water facilities. It urges realistic water rates and support for the forward-looking legislation and bond issues that will insure a plentiful supply for the future.

It's designed to help America . . . and you . . . conserve our most precious national resource . . . keep water flowing freely and abundantly for all.

CAST IRON . . . the pipe that's bought on proof, not claims

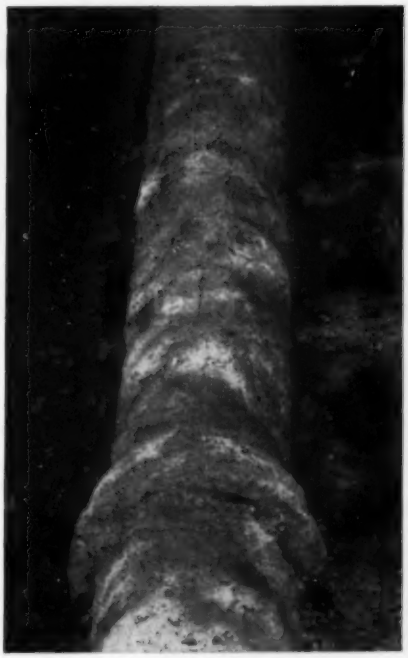
No other pipe can point to so convincing a record of long life.

Over 70 public utilities are served by cast iron mains laid over a century ago. This demonstrated record of long life not only gives the public the dependability it has a right to expect in a water system . . . it saves tax dollars as well. Once in the ground, cast iron serves for generations with minimum maintenance. Cast iron's long term economy pays off!

Today, water officials can rely on even better cast iron pipe. Modernized cast iron pipe, centrifugally cast, is tougher, stronger, more uniform. And where needed and specified it is cement-lined to assure sustained carrying capacity throughout its long service.

You specify wisely and well when you specify cast iron pipe for your water system. The experience of over 100 years proves you chose the best.

Cast Iron Pipe Research Association, Thos. F. Wolfe, Managing Director, 122 So. Michigan Ave., Chicago 3, Illinois.



Laid 120 years ago this cast iron water main continues to serve the taxpayers of Lancaster, Pa. Photo shows section of a line about 1½ miles long, laid in 1836, and still a part of the Lancaster water distribution system.

CAST Q IRON

The Q-Check stencilled on pipe is the Registered Service Mark of the Cast Iron Pipe Research Association.

pipe FOR MODERN WATER WORKS

S-curve section of 72-in. concrete pipe in place.

DENVER'S MOUNTING WATER NEEDS SUPPLIED WITH 27,000 FEET OF *CONCRETE PIPE*

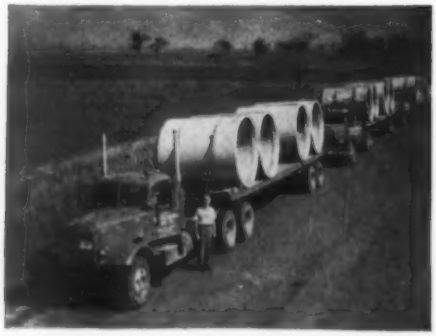
A shipment of four carloads of 72-in. pipe.

The Denver, Colo. Water Board has made available an extra 19,400 acre-feet of water per year for the city's growing needs with its St. Louis Creek Collection System.

The project, 80 miles west of Denver, required 27,000 ft. of concrete pipe 30 to 72 in. in diameter. Inasmuch as there was no head on these lines, reinforced concrete sewer pipe, ASTM Specification C-75, was used.

Like Denver, many other cities are using concrete pipe to supply their ever-mounting water needs. That's because concrete pipe water lines provide maximum capacity plus great strength and extra long life. No tuberculation or incrustation difficulties lower their hydraulic efficiency. The final result is true ***low-annual-cost*** water line service.

PORTLAND CEMENT ASSOCIATION
33 West Grand Avenue, Chicago 10, Illinois
A national organization to improve and extend the uses of portland cement and concrete . . . through scientific research and engineering field work



Three truckloads of 72-in. pipe enroute to job.

Contractor's pipe storage yard at the job site.

Cleveland "Baby Digger" averages 3,500' of 22" x 36" water line trench daily, digging in clay and rock

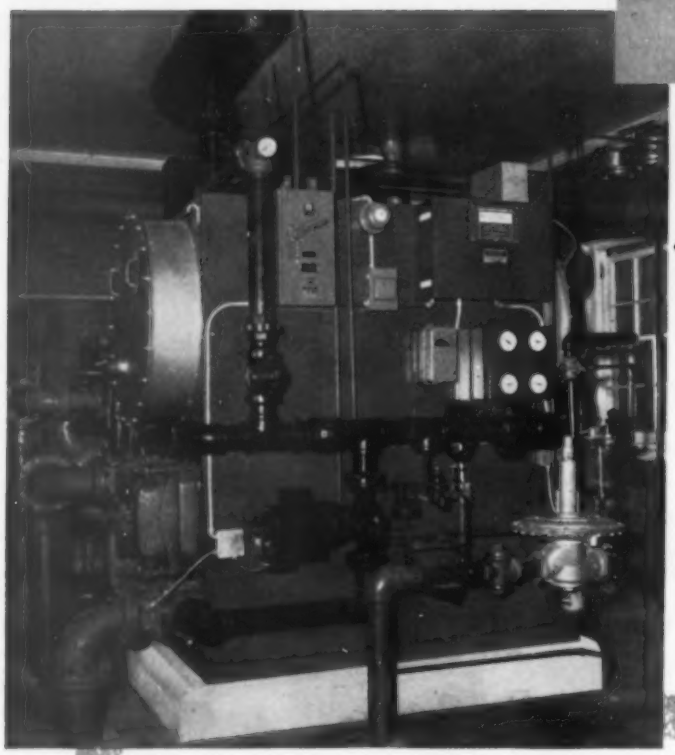
R. L. Eatherly of Carthage, Tenn. got good daily trench production with his Model 95 Cleveland "Baby Digger" on this water line contract in the Belshire Subdivision in Nashville. Averaging 3,500 feet per day, the Cleveland cut 4 miles of trench, 22 inches wide by 36 inches deep in curving roadways on a subsoil composed of clay with fairly heavy rock content. The Cleveland's completely unobstructed operator visibility and the convenient grouping and location of its controls for easy accurate digging were definite advantages in cutting the curved trench. Just another example of the outstanding ability of Cleveland Trenchers to *dig more trench . . . in more places . . . at less cost.*

Talk it over with your Cleveland distributor

THE CLEVELAND TRENCHER COMPANY • 20100 St. Clair Ave. Cleveland 17, Ohio

CLEVELAND

FLEXIBILITY for your digester sludge heating applications



WALKER PROCESS HEATX

HEATX at Urbana-Champaign, Illinois, Sanitary District rated at 750,000 BTU/hr.

Consulting Engineers-Wilson and Anderson Champaign, Illinois

Mr. E. J. Beatty - Supt. Sanitary District

The complete HEATX assembly consists of control panel, fire tube hot water boiler and tube within a tube heat exchanger. Absolute control of all functions is provided. Boilers are designed to burn either sewage gas, sewage gas and oil or sewage gas and natural gas.

The HEATX is available in standard sizes ranging from 100,000 to 2 million BTU/hr. output. Write for bulletin 24 S 82.

The Walker Process HEATX, for digester sludge heating is designed to provide the most efficient operation; plus flexibility in meeting the requirements of all applications.

For example, the HEATX, in addition to heating sludge at the proper temperature, can readily provide boiler water at a higher temperature for the building heating system. For further efficiency the piping of the HEATX is frequently arranged to permit the unit to utilize jacket cooling water from gasoline engines in the plant's standby power installation.

The boiler water is maintained at 180°, for efficient building heat, while water surrounding the sludge tubes is blended to 140° with thermostatic protection against temperatures where sludge heating demand is less than boiler capacity. Sludge and water velocities up to 4 ft./sec. guarantee high heat transfer coefficients and completely eliminate any danger of sludge caking.

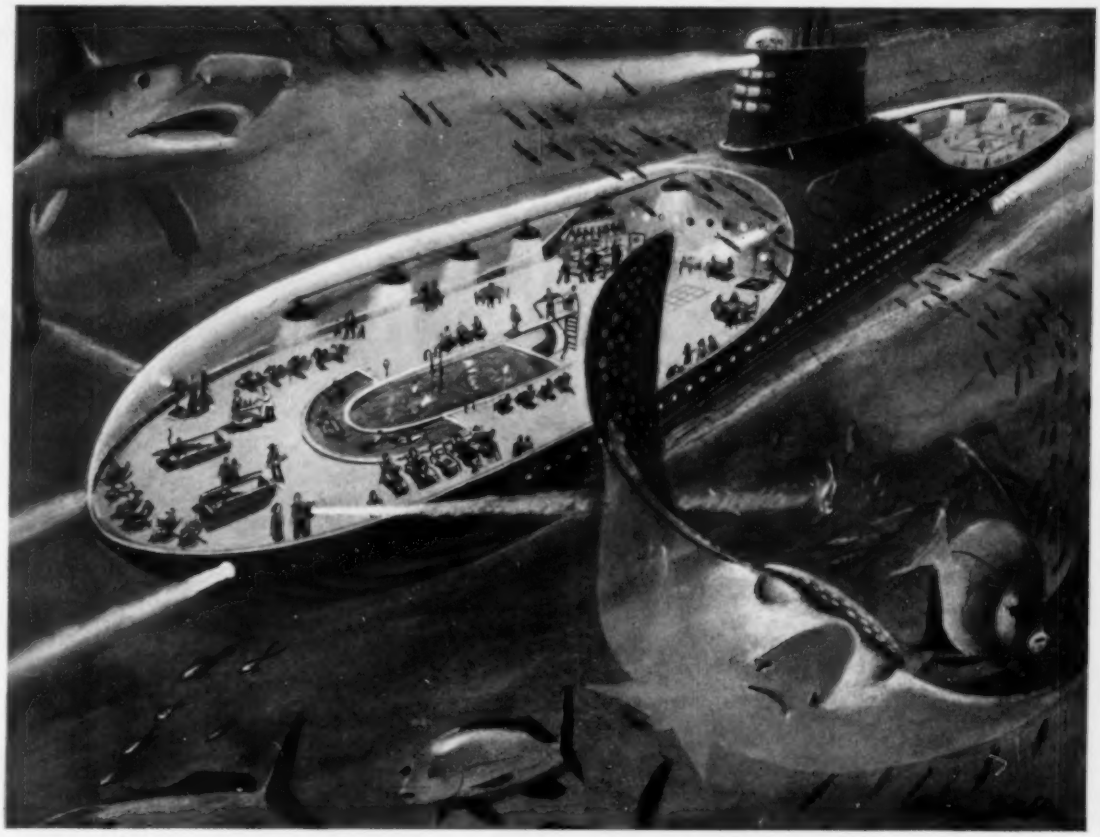
The HEATX is readily adaptable to any installation. Existing plants may utilize present boilers or engine jacket water as a heat source.

WALKER PROCESS

WALKER PROCESS EQUIPMENT INC.

Factory - Engineering Offices - Laboratories

AURORA, ILLINOIS



HUGE submarine liners with glass capable of withstanding tremendous pressure may offer the traveler of the future intimate glimpses of life under the sea and immunity from storms and seasickness.

100 years from now...

WE MAY SIGHTSEE UNDER THE SEA!

The world of the future—full of amazing, time-saving, health-giving products and machines. Still being used, however, will be the reliable cast iron water and gas mains laid today.

Records show that over 60 American cities from coast to coast are still served by cast iron water and gas mains laid more than a century ago. And modernized U. S. Pipe... centrifugally cast, quality-controlled from mines to finished product... is extra rugged, more dependable than ever.

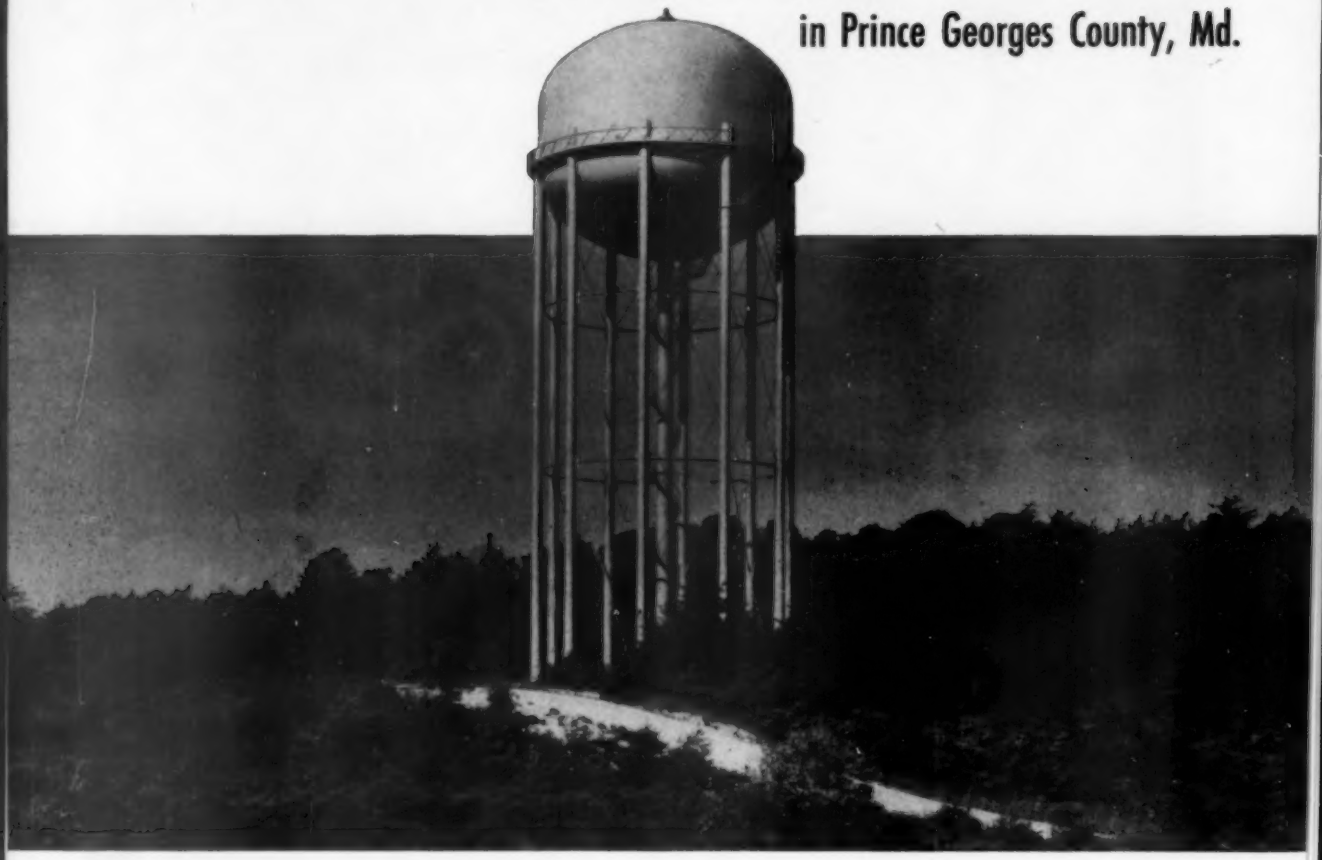
U. S. Pipe is proud to be one of the leaders in a forward-looking industry whose service to the world is measured in centuries.

U.S.
cast iron
PIPE
FOR WATER, GAS, SEWERAGE AND INDUSTRIAL SERVICE
CAST IRON

U. S. PIPE AND FOUNDRY COMPANY, General Office: Birmingham 2, Alabama

A WHOLLY INTEGRATED PRODUCER FROM MINES AND BLAST FURNACES TO FINISHED PIPE.

Water rides on a tall tower for better consumer service in Prince Georges County, Md.



Elevated Steel Tanks

by PITTSBURGH • DES MOINES

A million gallons of water, 160 ft high in this P-DM elevated steel tank, "rides" on the Washington Suburban Sanitary Commission system at a location distant from the source of supply. A relatively high head range of 47 ft accommodates the variations in supply pressure, so that water may always accumulate during off-peak hours and be available to augment the supply at peak demand periods. Diameter of the tank is 65 ft. • A broad picture of the many Pittsburgh-Des Moines Elevated Steel Tank types is provided in our illustrated 20-page brochure. Write for your free copy.

PITTSBURGH • DES MOINES STEEL CO.

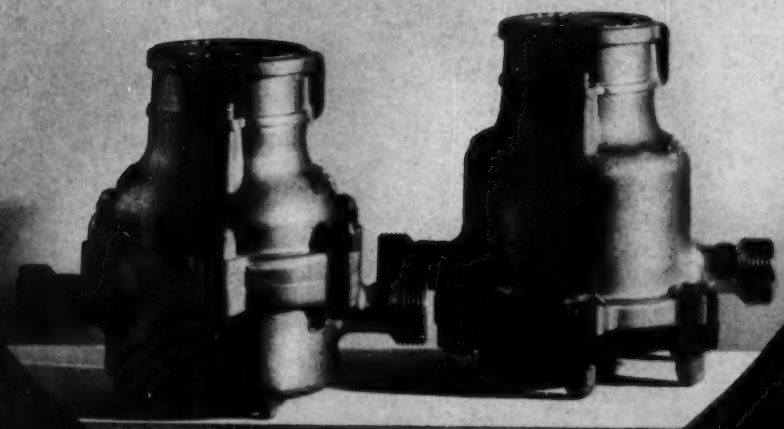
Plants at PITTSBURGH, DES MOINES and SANTA CLARA

Sales Offices at:

PITTSBURGH (25) ..... 3418 Neville Island	DES MOINES (8) ..... 913 Tuttle Street
NEWARK (2) ..... 218 Industrial Office Bldg.	DALLAS (1) ..... 1223 Praetorian Bldg.
CHICAGO (3) .. 1222 First National Bank Bldg.	SEATTLE ..... 526 Lane Street
LOS ANGELES (48) ..... 6399 Wilshire Blvd.	SANTA CLARA, CAL. ..... 625 Alviso Road

HERSEY

WATER METERS



HERSEY MANUFACTURING COMPANY

SOUTH BOSTON, MASS.

BRANCH OFFICES: NEW YORK — PORTLAND, ORE. — PHILADELPHIA — ATLANTA — DALLAS — CHICAGO
SAN FRANCISCO — LOS ANGELES

A HORTON ELEVATED TANK

for a new water system

When the influx of residents and visitors turned Hallandale, Florida, from a truck farming area into a tourist center, it became necessary to build the city's first water treatment and distribution system. Included in the city's new water system is a 200,000-gal. Horton® elevated tank that provides a reserve of water that will flow under gravity pressure to meet peak load periods and emergencies.

Write our nearest office for further information on a Horton elevated tank. They are built in capacities to 3,000,000 gals.

CBI

Chicago Bridge & Iron Company

Atlanta • Birmingham • Boston • Chicago • Cleveland • Detroit • Houston
Los Angeles • New York • Philadelphia • Pittsburgh • Salt Lake City
San Francisco • Seattle • Tulsa
Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PA.

MUELLER®

meet you in St. Louis*

*AWWA CONVENTION

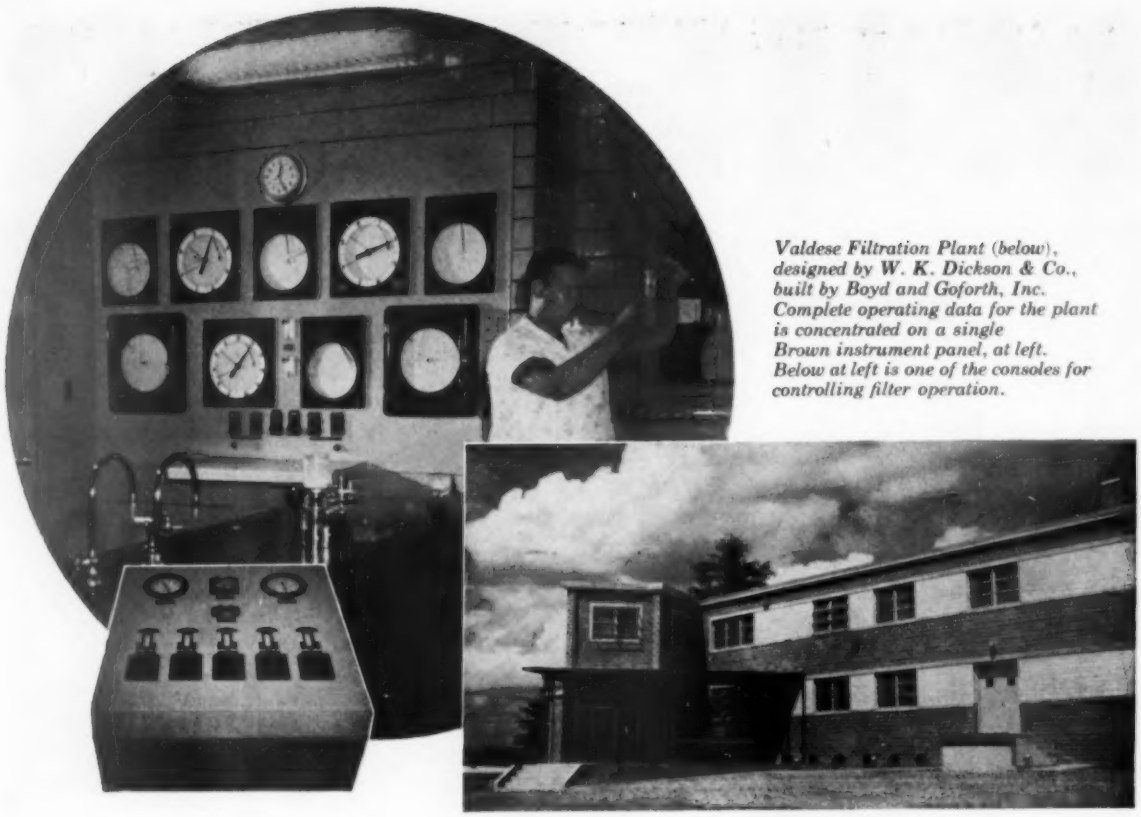
May 6-11, 1956

Drop by booths 110, 111 and 112 at Kiel Auditorium to see our *all new* waterworks equipment display.

Our congratulations to the American Water Works Association on their Diamond Anniversary. Its accomplishments and progress in promoting better knowledge of water purification and distribution services has contributed greatly to the growth of the industry.

75 YEARS OF PROGRESS
1881 1956

MUELLER CO.
Dependable Since 1857
MAIN OFFICE & FACTORY DECATUR, ILLINOIS



Valdese Filtration Plant (below), designed by W. K. Dickson & Co., built by Boyd and Goforth, Inc. Complete operating data for the plant is concentrated on a single Brown instrument panel, at left. Below at left is one of the consoles for controlling filter operation.

Honeywell engineered instrumentation automatically controls rapid sand filters

CONTROL of rapid sand filters, at the Valdese Water Filtration Plant, Valdese, N. C., is designed for maximum simplicity and convenience. From the central Brown instrument panel, operators have complete supervisory data on the entire operation . . . supplemented by individual console control of filtration rate and backwashing.

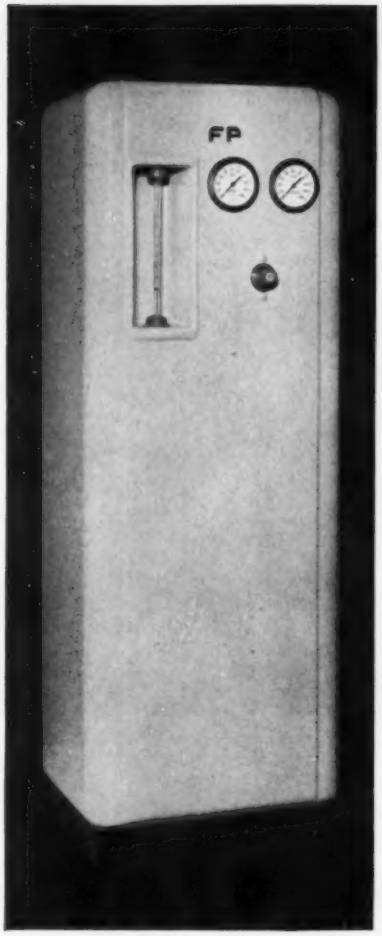
The Honeywell control system provides direct pneumatic operation of filter control valves, without need for the complexities of pneumatic-hydraulic relays. Valves 16" and larger can be opened or closed at the turn of a switch. Rate of filtration, too, is a single switch adjustment. Control is so designed that the plant automatically shuts down when levels in the reservoir and clear wells reach maximum limits.

This simplified system assures reduced costs for initial installation and for day-to-day operation of the plant. It provides maximum economy of treatment agents and water, through close correlation with laboratory testing. Pipe galleries stay clean and dry. And operators can supervise the functioning of the plant efficiently, without waste of time and power.

For the new water or waste treatment facilities you are planning, it will pay to have a Honeywell field man discuss Honeywell's field-proven new automatic filter control, with you and your consulting engineer. Call him today . . . he's as near to you as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.—in Canada, Toronto 17, Ontario.

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls



FP *complete process instrumentation*

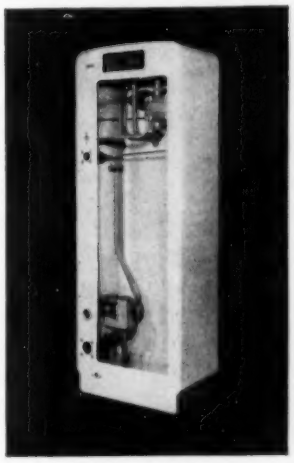
F&P Offers 5 Chlorinators from One Basic Unit

Principal components identical for all functions

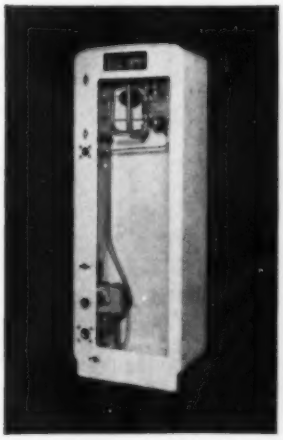
Fischer & Porter's basic chlorinator design is now available with five optional variations—manual, automatic proportioning, multiple rate, remote set, fluo-chlorination (simultaneous fluorination-chlorination).

The simplicity of the manually operated chlorinator is preserved in all variations, and since all functional components remain essentially unchanged, a minimum spare parts inventory is required.

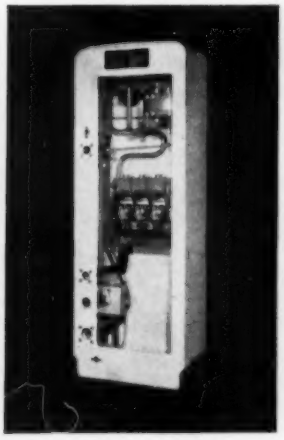
Fischer & Porter offers a wide variety of chlorinators for use in water and sewage treatment systems, industrial plants, swimming pools. Consult your local F&P representative or write for free literature.



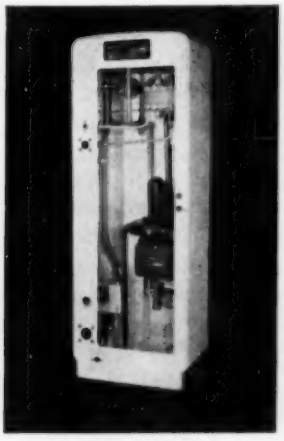
Manual, Model C-1410
(Catalog 70-10)



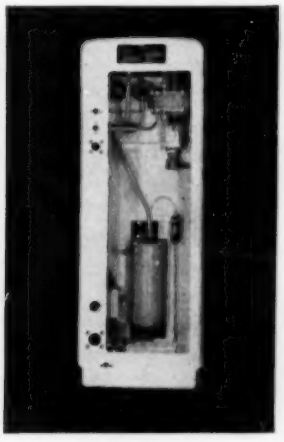
Automatic proportioner, Model C-1420
(Catalog 70-23)



Multiple rate, Model C-1444
(Catalog 70-26)



Remote set, Model C-1455
(Catalog 70-24)



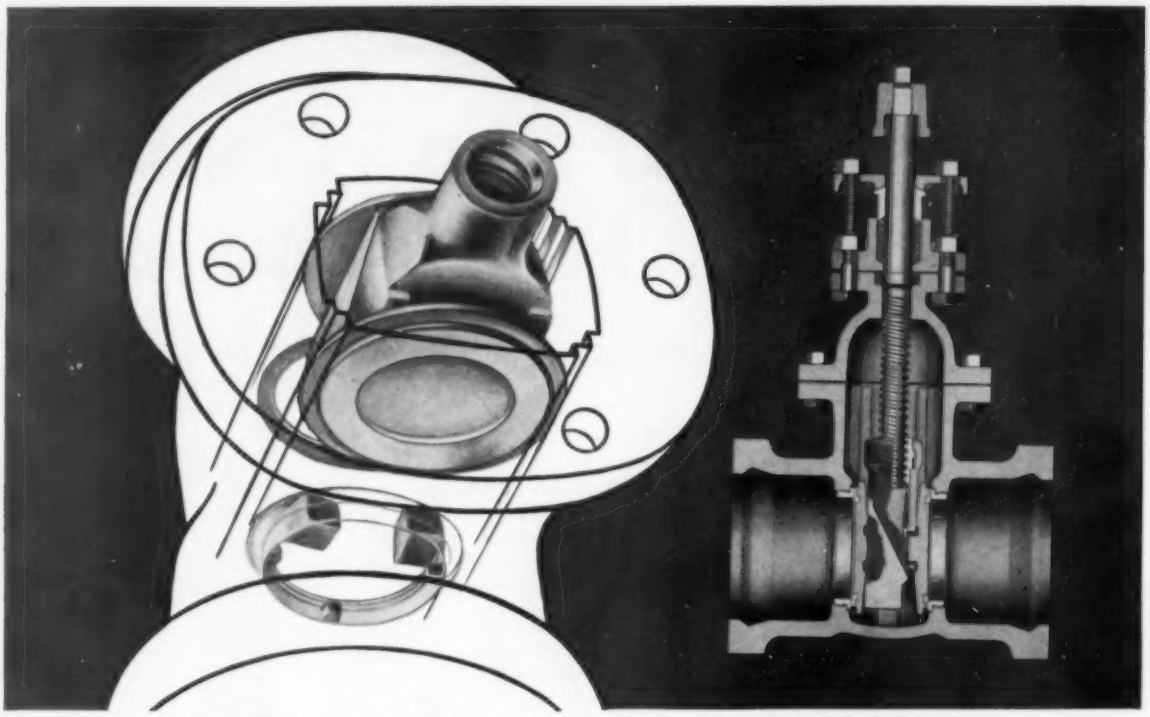
Fluo-chlorination, Model F-1410
(Catalog 70-25)

FISCHER & PORTER COMPANY

146 FISCHER ROAD • HATBORO, PA.

Measuring, recording and controlling instruments
Centralized control systems
Data reduction and automation systems
Chlorination equipment
Industrial glass products

Sales offices in 32 American cities and in principal cities abroad



The outline drawing shows how the simple, 4-piece disc assembly is held in alignment by the guide ribs. As the disc assembly descends on the stem, the lower spreader strikes a boss in the body. Further closing movement exerts pressure on the spreaders in a wedging action, forcing the parallel discs tightly against the seats.

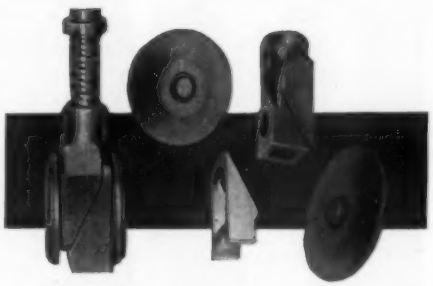
New Crane disc assembly and guide rib design improve efficiency of AWWA valves

Two design features—a simple, 4-piece disc assembly and a unique guide rib design—function together to make Crane's new AWWA double-disc gate valves a wise choice for mains and distribution lines.

The double-disc assembly, held in close alignment by the new guide rib design, cannot jam or become disengaged in service. The trunnion-mounted discs are free to rotate as they are raised or lowered, preventing concentrated wear on both discs and seats. And, the rotary motion of the discs tends to clean the seating areas.

The new Crane double-disc gate valves meet all AWWA specifications—and more! For example, the 2-piece gland and gland flange with ball type joint is well-known for preventing stem binding even though uneven pull-up may be applied on gland bolts.

These quality AWWA valves are available in sizes from 2″ to 12″. Conforming to AWWA specifications, they are bronze-trimmed and have non-rising stems. For complete specifications, contact your local Crane Representative, or write to address below.



This view of the disc assembly shows simplicity of design that makes it foolproof in action. Entire assembly is suspended freely in valve body from stem, which engages upper spreader. Discs are suspended from upper spreader by trunnion principle.

CRANE VALVES & FITTINGS

PIPE • KITCHENS • PLUMBING • HEATING

Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas

Today's water Supply-

is your community's most valuable asset!

Badger Meters provide a precise check on usage and waste . . . first logical step towards conservation.

This perplexed citizen is a victim of water shortage — fast becoming a major problem in many communities. The tools he holds in his hands hardly equip him to fight for his rightful share — *he needs help from his water department.*

What YOU do *now* to safeguard *present water* supplies — to prevent situations like this —may play an important part in future development of your own community.

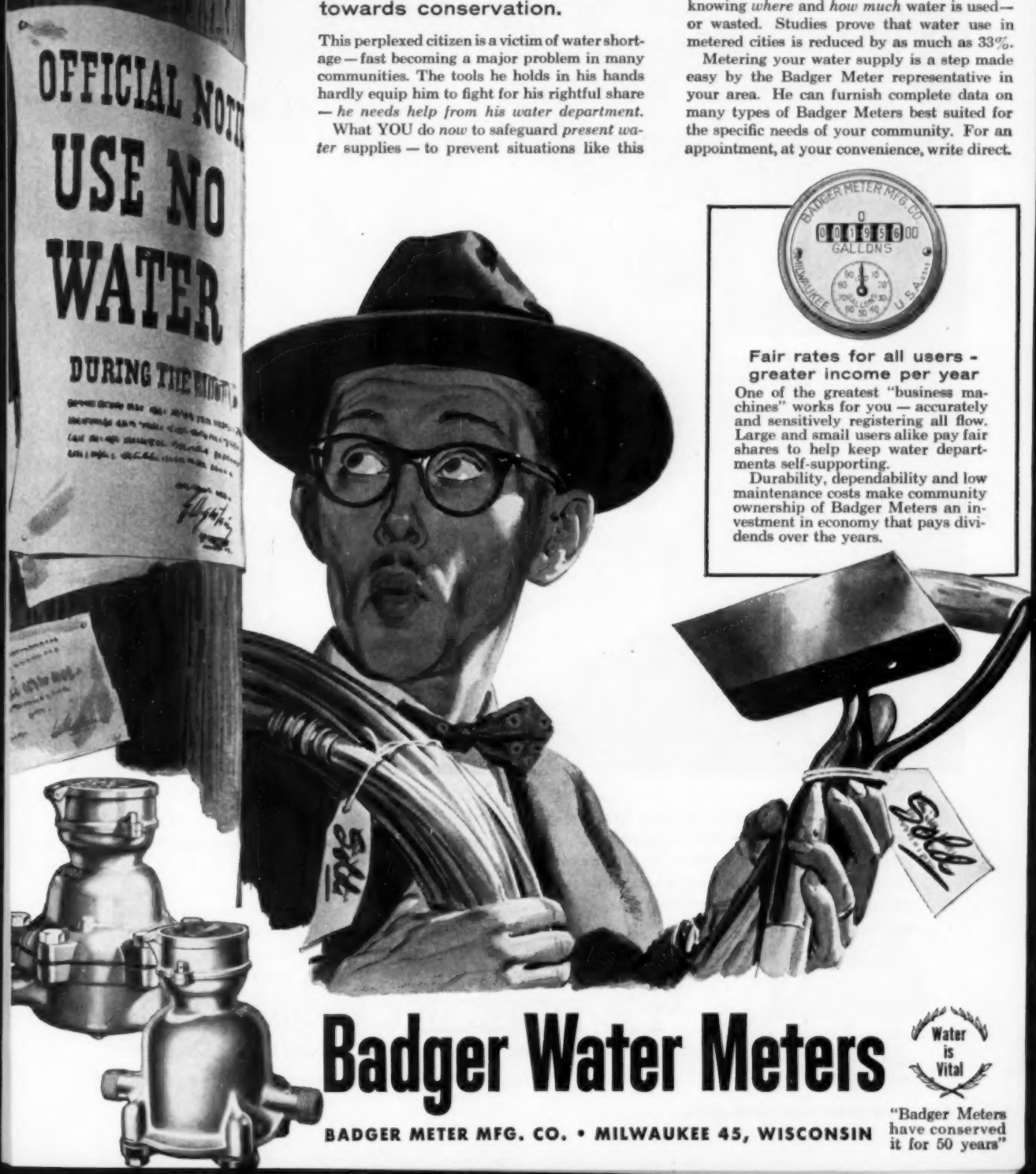
Metering all water for residential and industrial use is the first logical step towards knowing *where* and *how much* water is used—or wasted. Studies prove that water use in metered cities is reduced by as much as 33⅓%.

Metering your water supply is a step made easy by the Badger Meter representative in your area. He can furnish complete data on many types of Badger Meters best suited for the specific needs of your community. For an appointment, at your convenience, write direct.

Fair rates for all users - greater income per year

One of the greatest "business machines" works for you — accurately and sensitively registering all flow. Large and small users alike pay fair shares to help keep water departments self-supporting.

Durability, dependability and low maintenance costs make community ownership of Badger Meters an investment in economy that pays dividends over the years.



Badger Water Meters

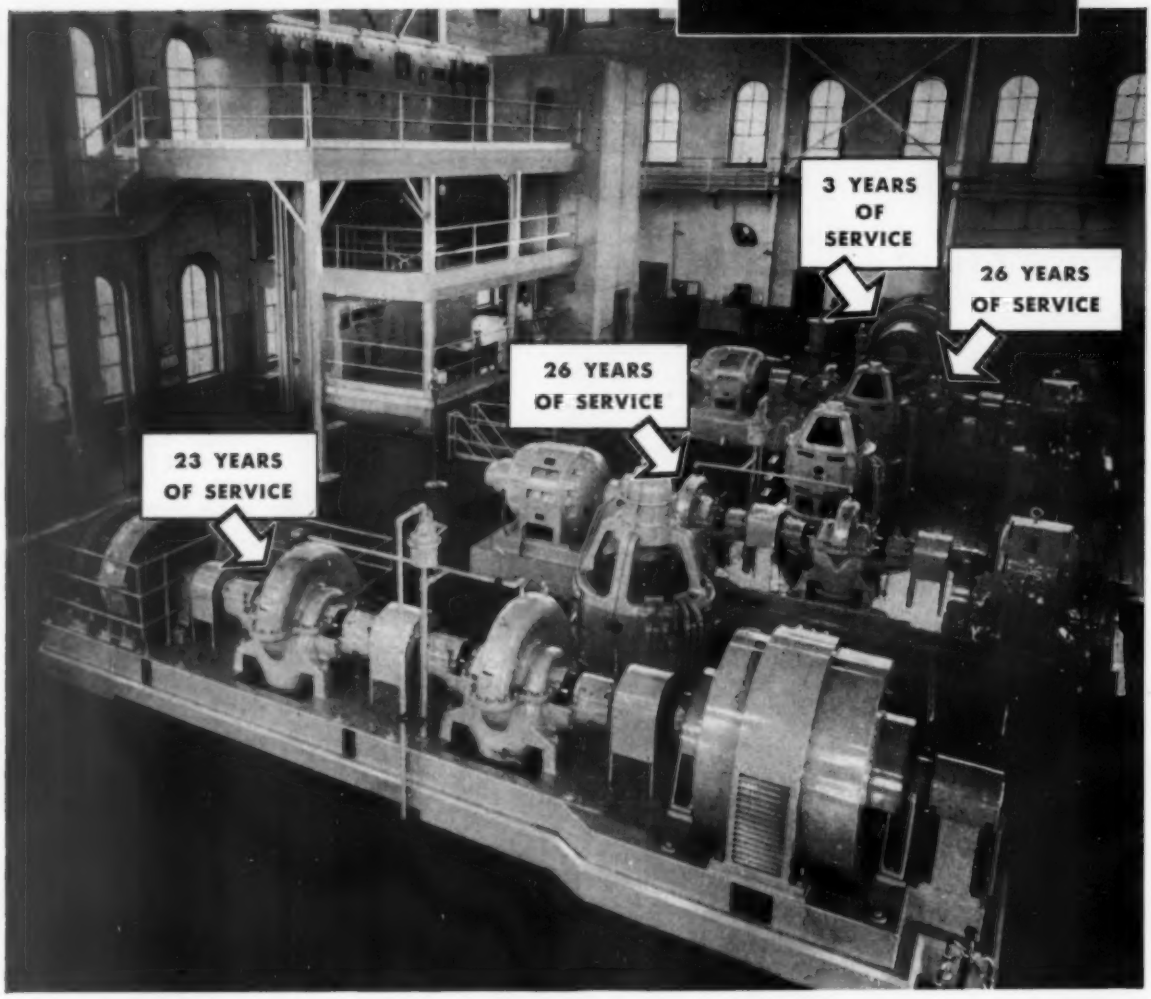
Water is Vital

BADGER METER MFG. CO. • MILWAUKEE 45, WISCONSIN

"Badger Meters have conserved it for 50 years"

Nashville goes to 100 mgd with

DE LAVAL
CENTRIFUGAL PUMPS



The years of service shown on these De Laval centrifugal pumps tell their own story of dependability and progress. By revising its facilities, the George Reyer pumping station in Nashville has boosted its pumping capacity to 100 million gallons per day.

The De Laval pumps play an integral part in this more efficient operation. For example, the newest De Laval unit handles 40 million gallons per day.

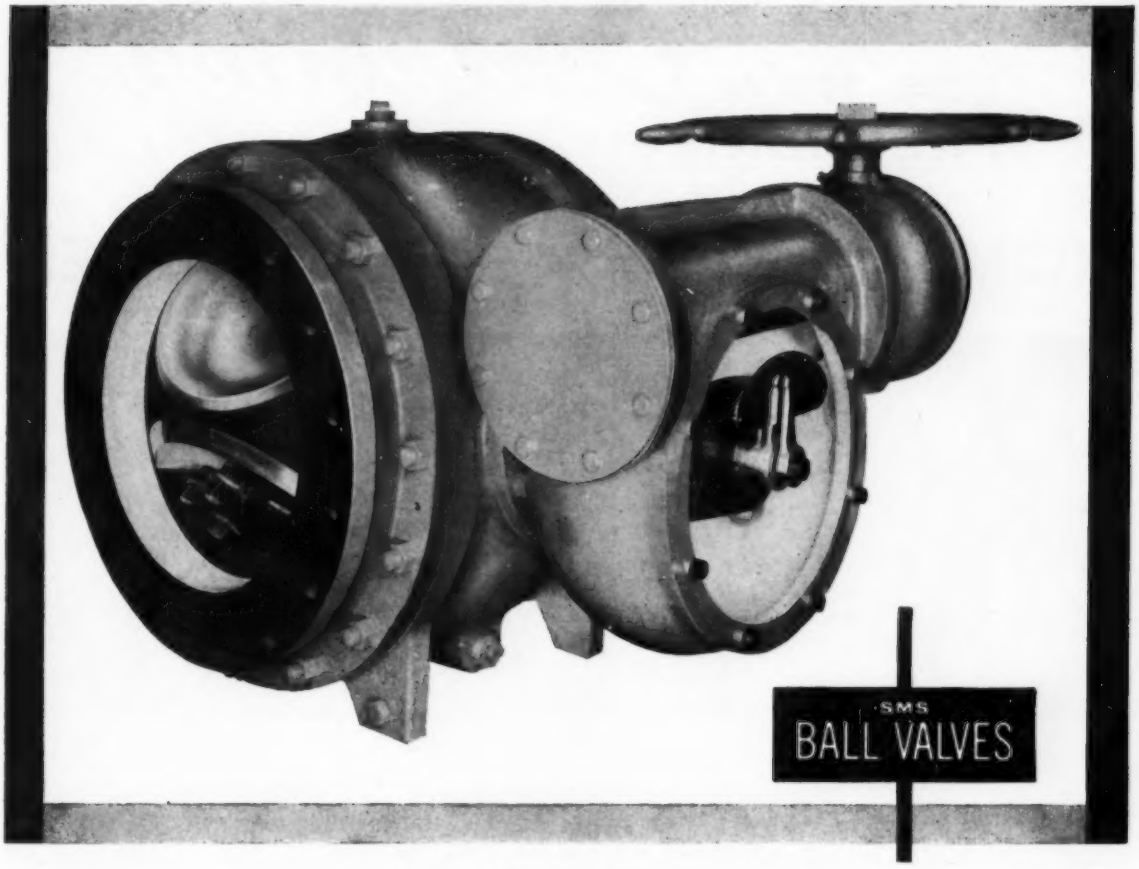
In fact, 80% of all cities in the United States, with a population of 100,000 or over, use De Laval centrifugal pumps. Capacities of De Laval centrifugal water works pumps range from 100 thousand to 100 million gallons per day. Write for your copy of new De Laval Bulletin 824.

DE LAVAL *Centrifugal Pumps*

DE LAVAL STEAM TURBINE COMPANY

824 Nottingham Way, Trenton 2, New Jersey

CL 304



FLOW ITSELF HELPS MAKE SMS BALL VALVES EASY TO CLOSE

Flow velocity actually assists the closing operation of SMS Ball Valves. With the hydraulic action boosted by the powerful leverage of the simple link and lever mechanism (visible through the lucite cover of the demonstration model above), the valve is remarkably easy to close. The wedging action of the metal-to-metal seats assures drop-tight closure.

In the open position, the valve is like a straight length of pipe. Pressure drop and turbulence are kept to a minimum, resulting in lower pumping costs and longer valve life.

The high quality and performance characteristics of SMS valves are guaranteed by more than 75 years of research and engineering. To get detailed information about our complete line of Ball Valves, Rotovalves and Butterfly Valves, contact your local representative, or write to the S. Morgan Smith Company, York, Pennsylvania.

S. MORGAN SMITH

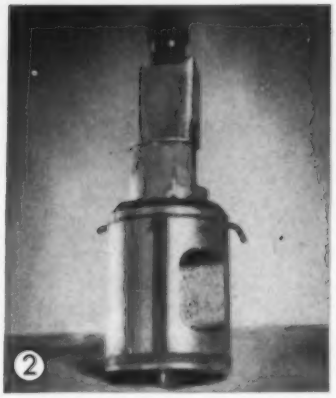
AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO

HYDRAULIC TURBINES
PUMPS
GATES & HOISTS
TRASH RAKES
ACCESSORIES
HYDRODYNAMICS
ROTOVALVES
BALL VALVES
BUTTERFLY VALVES
FREE DISCHARGE VALVES
CONTROLLABLE-PITCH SHIP PROPELLERS

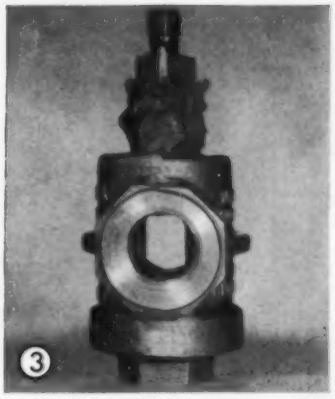
*SEE HOW *Controlled*
PRESSURIZED LUBRICATION
GUARANTEES LOWEST COST SERVICE FROM

HOMESTEAD *lubricated* PLUG VALVES

This plug was removed from a Homestead Valve just after starting lubrication, and before all sealing areas were filled with lubricant. Note that pressurized lubricant continues to extrude through feeder holes. Momentary downward movement of plug at start of each lubrication, gives assurance that plug is always free to turn.



The plug was again withdrawn from the valve body just after a ring of lubricant around the stem indicated that the lubricant system was full. Note that all lubricant grooves are filled. The entire plug surface is coated with lubricant. Lubricant is well packed in the stem sealing area above the plug.



Now valve has been purposely over-lubricated as indicated by excess lubricant around stem. Note that with *controlled* pressurized lubrication there is no extrusion or seepage of lubricant into valve port opening. This means no waste, no contamination of line fluids, no clogging of low pressure lines with lubricant, or fouling of meters, orifices, etc.

Also, in the Homestead Valve with *controlled* lubrication, you will note that even though the valve has been over-lubricated, lubricant comes only to the bottom edge of the plug, and is not wasted by discharging in quantity into the bottom chamber.

Now, see for yourself the risk involved when a valve which does *not* have Homestead's *controlled* Pressurized Lubrication, is over-lubricated. Note lubricant has been forced into the port opening. It can contaminate line fluids, foul meters or orifices, or even block low pressure lines!

*Unretouched photos.

These are but a few of the many advantages of Homestead's controlled pressurized lubrication that guarantee lowest cost valve service.

Reference Book 39-5 has the full story—twenty-eight pages of engineering facts, sizes, types, dimensions, etc. Ask for your copy today. There is no obligation.

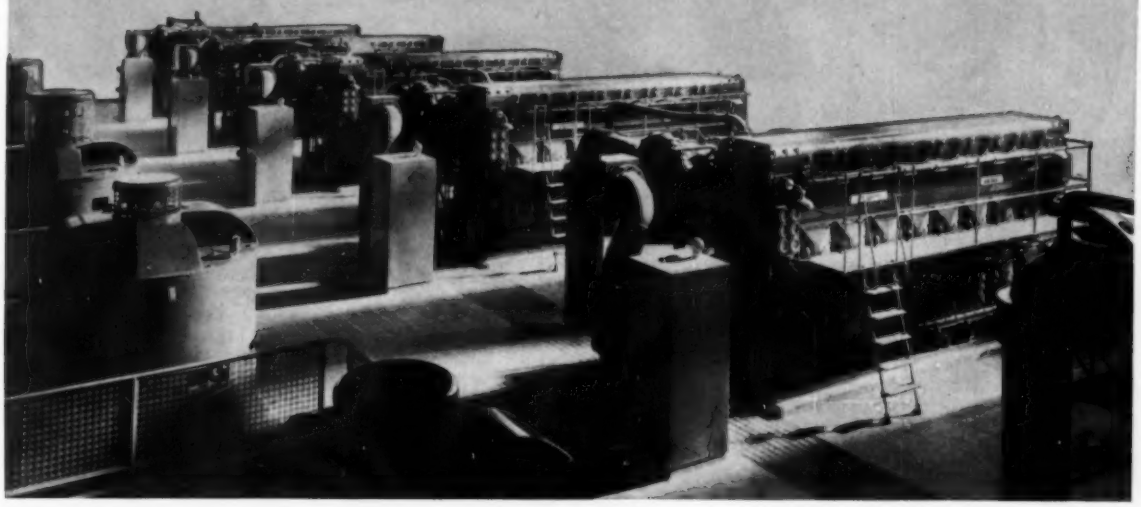
HOMESTEAD LUBRICATED PLUG VALVE (Pat. Pend.)

HOMESTEAD VALVE MANUFACTURING COMPANY

P. O. Box 42 *"Serving Since 1892"* Coraopolis, Pa.

Superior DUAL-FUEL ENGINES CUT OPERATING COSTS

in New York sewage treatment plant



Six Model 80 Superior Dual-Fuel Engines, operating 92% of the time on sewage gas, run six 1125 KVA generators to provide the sole power source for all plant equipment at The Department of Public Works, Owl's Head Sewage Treatment Plant, New York City, having a capacity of 160 million gallons per day.

After a total of 78,000 hours running time, the New York maintenance crew completed the first overhaul of the six Superior engines. Practically no major part replacements were necessary! There was no noticeable wear on the cylinder liners, bearings or other vital parts! Since the engines were torn down, piston rings were replaced; but the old rings were still good enough to save for spares! Records show very low lube oil consumption and pilot fuel costs figure out to only 9 tenths of a mill per KWH. This Superior performance is cutting operating costs to a bare minimum at New York's Owl's Head Plant!

Similarly outstanding performance records are being established throughout the U.S.A., and most other parts of the world where Superior and Atlas Diesels are used for all kinds of power needs. For complete details on how Superior and Atlas power can cut operating costs for you, contact the nearest sales and service office listed below.

Superior ENGINES · ATLAS Imperial DIESEL ENGINES · White DIESEL

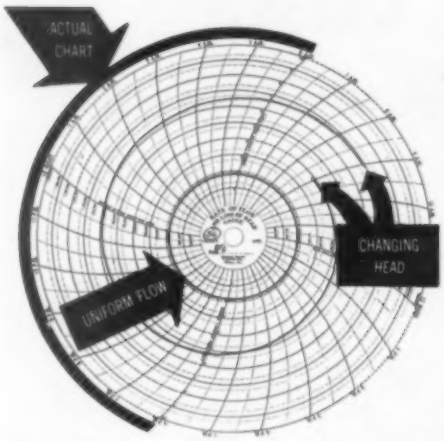
WHITE DIESEL ENGINE DIVISION

THE WHITE MOTOR COMPANY • ***Plant and General Offices: Springfield, Ohio***

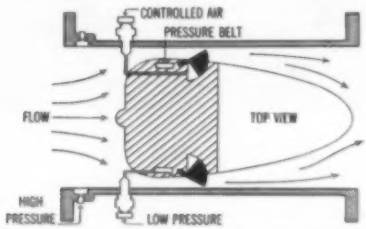
SALES AND SERVICE POINTS: Gloucester, Mass. • Houston, Ft. Worth, Texas • San Diego, Oakland, Terminal Island, California • Ketchikan, Alaska • Washington, D.C. • Portland, Astoria, Oregon • Casper, Wyoming • Halifax, Nova Scotia • Vancouver, B.C. • Park Rapids, Minnesota • New York • Chicago • Seattle • New Orleans • St. Louis • Wichita, Kansas

NEW SIMPLEX FILTER RATE CONTROLLER GIVES YOU COMPLETELY PNEUMATIC CONTROL!

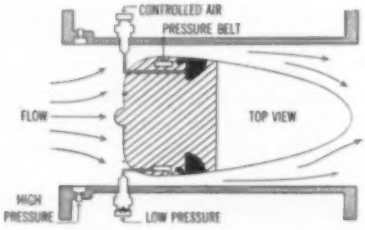
Amazing Modulair® Controller responds fast . . . closes tight



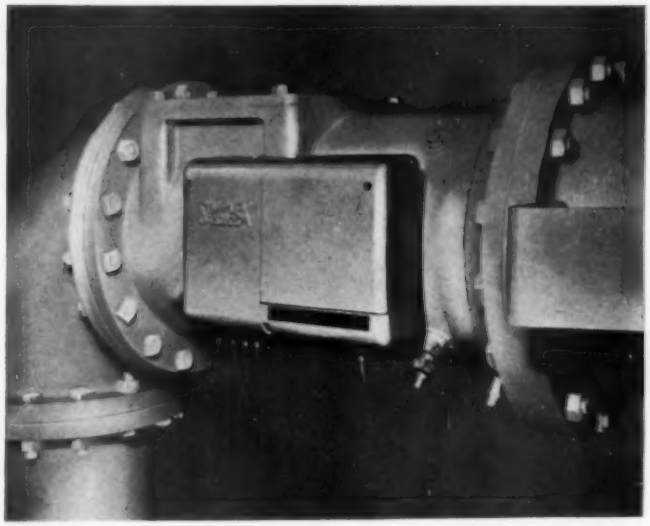
Here's proof that the new Simplex Modulair Filter Rate Controller responds instantly to changes in filter head, holds flow at desired rate . . . automatically! In chart from Modulair installation No. 2, head changes from 4′ to 7′ while rate forms almost perfect circle at the set 275,000 gpd.



How Modulair works! Pipe-like casting with annular Venturi throat houses streamlined inner body with corded-rubber modulator (black) that expands and retracts pneumatically to control flow. When head is low at start of run, modulator expands automatically to hold flow at set rate.



As filter head loss rises, flow tends to decrease . . . and change the Venturi differential. Sensitive Modulair compensates by instantly retracting the pneumatic modulator, maintaining a constant head-loss value through the combined filter and controller, automatically keeping flow at set rate!



Compact . . . easily installed Modulair is only two to three pipe diameters long! It fits wherever a piece of pipe can fit . . . in any position, horizontal or vertical . . . simplifying pipe gallery layout. High-grade, cast iron Modulair comes in 4" to 24" standard pipe sizes with corrosion-resisting fittings. Cord-inserted rubber throttling element that's as tough as a truck tire has given 30 years' wear in accelerated life-tests.

Accuracy! In 4 years of field performance, Modulair charts show an accuracy in filter control that exceeds today's most exacting demands. This high degree of control extends for wide ranges of head loss and flow rates, including complete, tight shut-off! And there's no drift at end of run.

Longer filter runs! Modulair combines a low head-loss, annular Venturi measuring element with a streamlined throttling element. This new design offers so little resistance to flow that you get longer filter runs, big savings in wash water!

Minimize maintenance! With Modulair's new design, there's no place for air to accumulate . . . no place for sand to lodge and interfere with accuracy. Throttling element, the only moving part inside pipeline, is non-corrosive rubber. Pneumatic poise element is simple, rugged. There are no line valves, no pilot valves, no pistons, no valve shafts, no stuffing boxes to pack!

Lower first cost! Modulair's low head loss means lower operating head requirements . . . permits vertical compression in plant design and lower costs in plant construction.

Completely pneumatic! No intermediate hydraulic steps! No pilot valves! No hydraulic cylinders! Air loading pressure is applied *directly* to the flow controlling element.

Automatic filter operation! Modulair works with control systems of any type to give you remote rate control or master pneumatic control that's fully automatic.

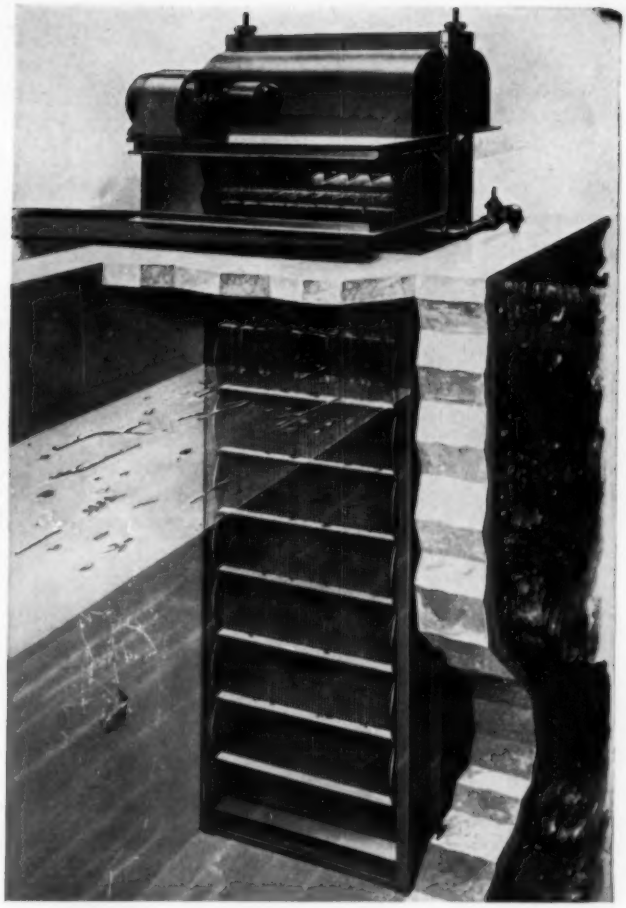
Technical bulletin! For full details on Modulair, write for Bulletin 950. Simplex Valve & Meter Company, Dept. WS-4, 7 East Orange Street, Lancaster, Penna.

Accurate instruments and controls for over 50 years

SIMPLEX®

VALVE AND METER COMPANY

eliminate destructive foreign matter in your influent...



JEFFREY traveling water screens remove floating debris and suspended matter from raw water.

An endless chain of traveling screen panels, moving upward on the entrance side, carries refuse to surface. High pressure water spray washes screen deposits into carry-away trough.

USE—in all plants requiring large volumes of water.

EASY INSTALLATION—Compact unit consists of vertical traveling screen, screen baskets, chain, sprays, guides, drive unit, frame, and semi-enclosed housing.

OPERATING ECONOMY—Enclosed ball bearing motor, anti-friction bearing speed reducer with gears running in oil, non-clog spray pipes with quick-opening valves.

STURDY CONSTRUCTION—Welded steel baskets, steel thimble roller chain, cast iron chilled rollers, cold roll steel head and foot shafts, fine mesh wire screen, ⅜-inch structural steel frame.

COMPLETE PROTECTION—End skirts form seal as baskets pass through boot. Adjacent basket cross members overlap to seal basket joint. End skirt flanges cover chain. Speed reducer has overloaded protection.

Jeffrey's broad experience in design and construction covers all types of sanitation system installations. Hundreds of municipal plants and private industrial plants over the entire nation are Jeffrey-equipped. The Jeffrey line includes:

Bar and Disc Type Screens	FLOCTROLS
Screenings Grinders	Dry Feed Chemical Machines
Grit Collectors & Washers	Biofiltration Plant Equipment
Sludge Collectors	Garbage Grinders
Sludge Elevators	Belt and Spiral Conveyors
Scum Removers	Bucket Elevators
Power Transmission Machinery	Chains and Sprockets

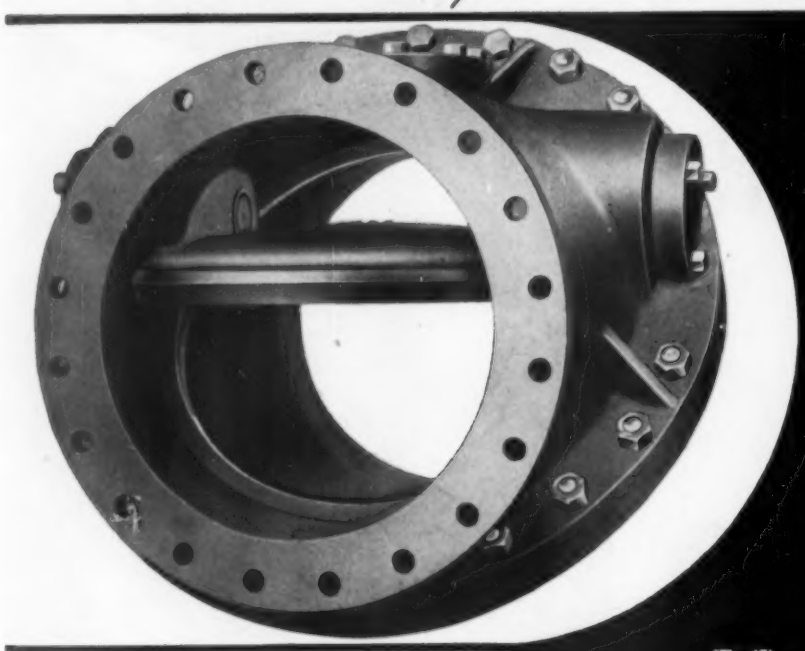
Traveling Water Screens

Write Sanitation Sales Division. The Jeffrey Manufacturing Co., Columbus 16, Ohio.

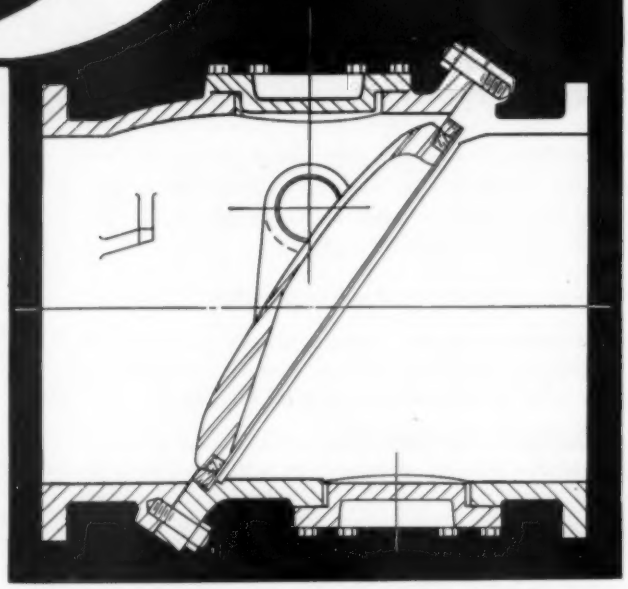
JEFFREY

CONVEYING • PROCESSING • MINING EQUIPMENT
TRANSMISSION MACHINERY • CONTRACT MANUFACTURING

CHAPMAN TILTING DISC CHECK VALVE



the Valve with the Right Idea!



Here is a cross section of top check valve performance at lowest cost. It's the idea in back of Chapman's Tilting Disc Check Valve . . . the valve that's designed to go with the flow.

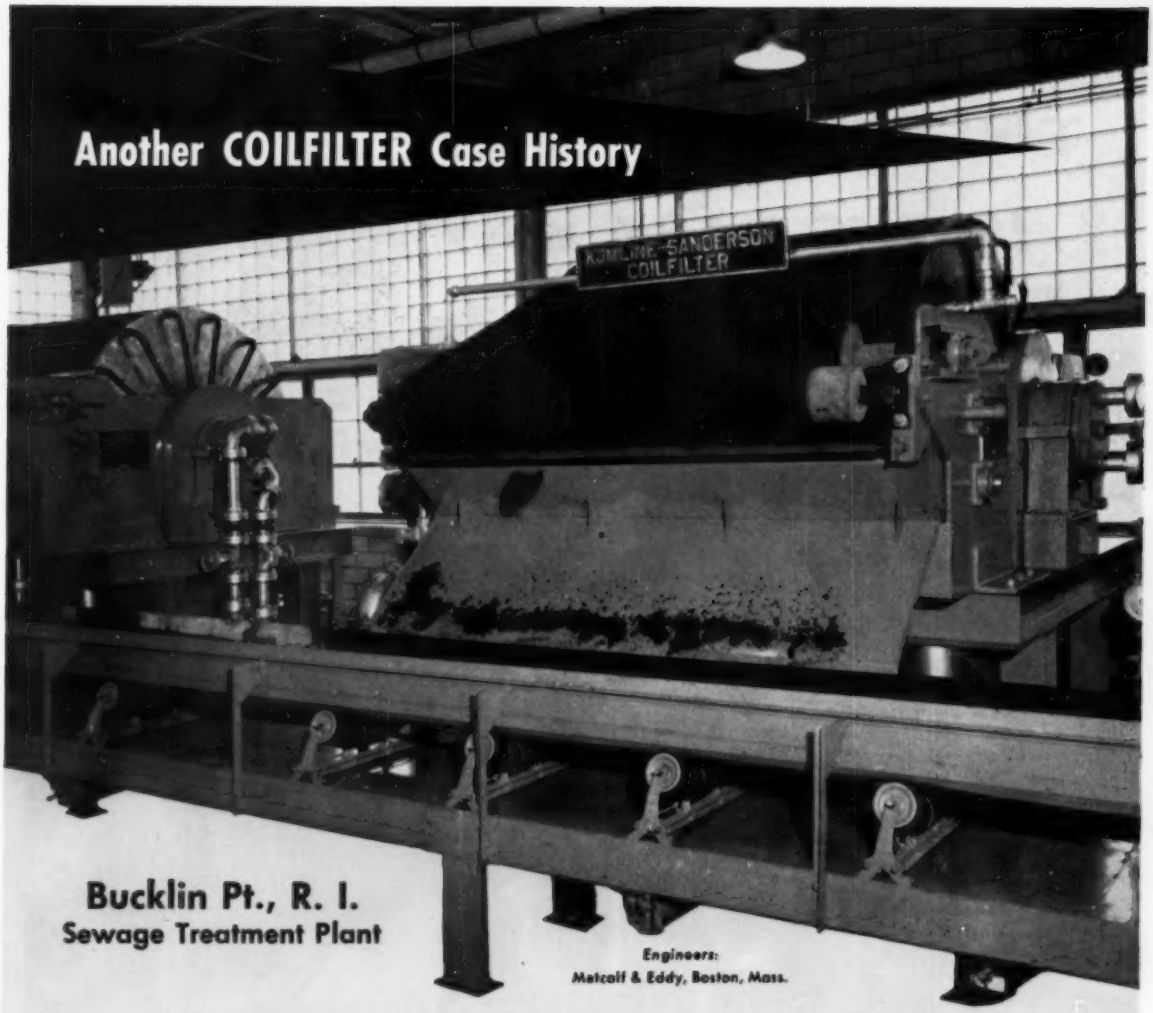
When the flow is on, specially designed "airfoil" disc balances perfectly in open position. Fluid holds it tightly against stops. There's no vibration . . . no flutter. It's quiet. And note the design. Ample room is allowed around disc to assure low flow resistance.

When the flow is reversed, disc drops surely, quietly, *tightly* on special beveled seat. There's no banging, no slamming, no scraping or wearing of disc and seat faces, no damage to piping joints or the valve itself. It's as simple as that. It's as *sound* as that. It has the right idea.

Complete information on these rugged, quiet, long life check valves is highlighted in our Catalog 30-A. Whether you want iron or steel construction . . . whether you handle fluids or gases under a wide range of pressures . . . this catalog gives you all the facts. Send for your up-to-date copy, today.

The CHAPMAN VALVE Mfg. CO.

INDIAN ORCHARD, MASS.



Another COILFILTER Case History

Bucklin Pt., R. I.
Sewage Treatment Plant

Engineers:
Metcalf & Eddy, Boston, Mass.

The Bucklin Point Sewage Treatment Plant in East Providence, R. I., operated by the Blackstone Valley Sewer District Commission, is a primary treatment plant with digestion and elutriation, designed to serve a population equivalent of 210,000, with a flow rate of 47.2 MGD and an average of 19,500 lbs. of sludge to be dewatered per operating day.

Three 100 Sq. Ft. COILFILTERS which dewater the sludge at Bucklin Pt., started operating in 1953. These units have performed excellently from the start, producing an average filter rate of 6-7 lbs. per hour per Sq. Ft. of filter area. Operating cost has been extremely low, only 2-3% ferric chloride being used to condition the sludge. No special maintenance is required. Two COILFILTERS are normally operated daily. Filter cake is discharged to a belt conveyor and then hauled away by truck to a sanitary fill.

C. V. (Buck) Hickey, Plant Superintendent, states: *"We have been very pleased with our* COILFILTERS *from the beginning, due to their outstanding performance, dependability and low operating cost. In addition, the ease of maintenance, partly due to the accessibility of all points requiring lubrication and adjustment, combined with the excellent general layout of this plant, make this a truly modern installation."*

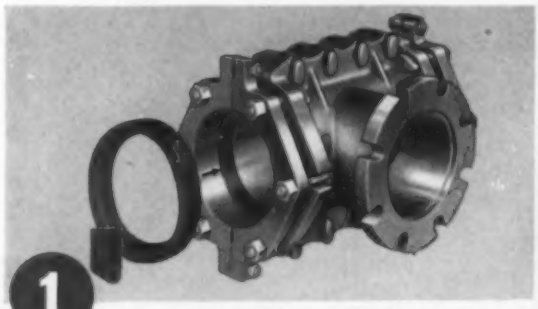
Remember . .
COILFILTER
. . the proved leader of sludge vacuum filters

KOMLINE-SANDERSON ENGINEERING CORPORATION
Peapack, New Jersey
Manufacturers of COILFILTER Sludge Vacuum Filters

For tapping mains under pressure

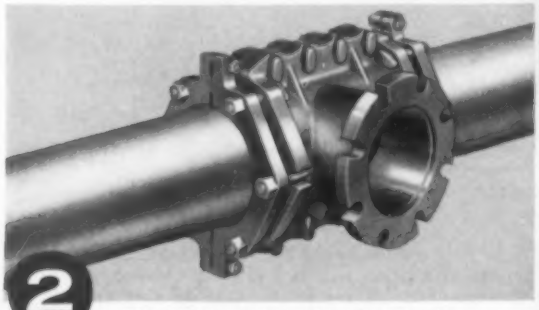
THE *EDDY* WAY *IS THE EASY WAY*

faster, simpler, too!



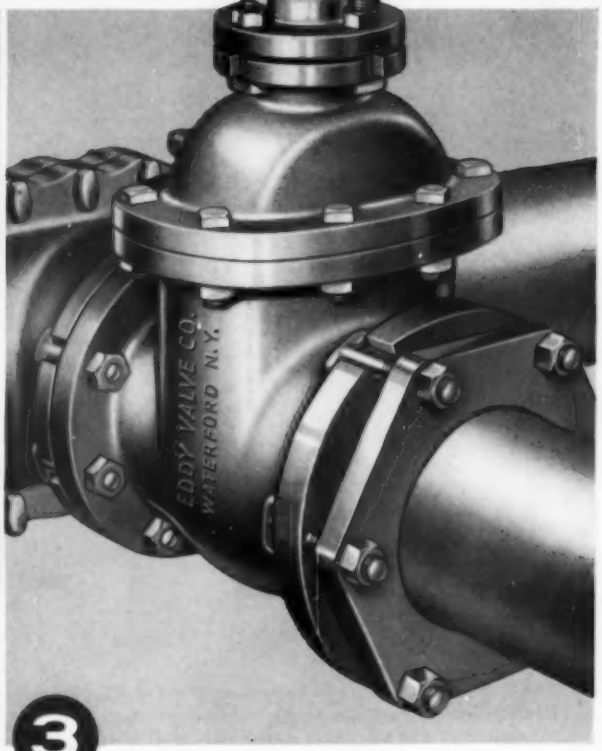
1 **Strength To Withstand Tapping Strain**

The extra length and heavy-duty, ribbed construction give strength to withstand strain of the tapping operation. Helical spring in gasket prevents extrusion between pipe and sleeve. Always a tight, permanent seal!



2 **Fits All Pipe—Assembles In Minutes**

Specially designed, armored gasket seals end flanges . . . and fits either AWWA or centrifugally cast pipe diameters. One man can assemble the Eddy Mechanical Joint Sleeve in minutes . . . even in a wet trench . . . with only a ratchet wrench. Tee-head bolts fit in notched flange . . . can't slip or turn when assembling.



3 **And After The Tap Is Made . . .**

. . . the standardized mechanical joint of the Eddy Tapping Valve permits fast assembly of the pipe for the branch line. Eddy Mechanical Joint Tapping Valves offer the same rugged, quality construction of *all* Eddy AWWA valves . . . that give years and years of dependable service.

EDDY mechanical joint tapping valves and sleeves

No Service Interruptions When You Connect Branch Mains the Easy, EDDY Way

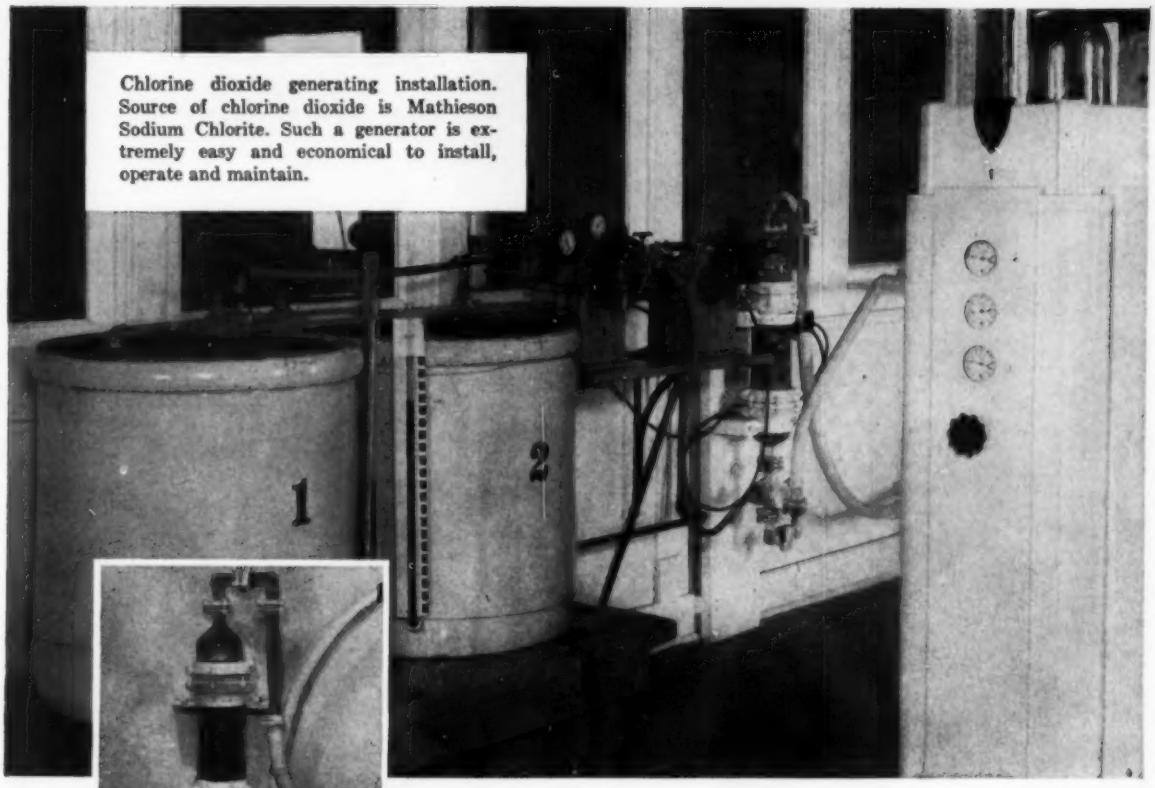
Here's the most practical . . . and economical . . . way to connect branch mains. So simple even unskilled labor can do it right . . . every time. So sure you needn't ever worry about interrupting water service . . . no need closing valves to shut off mains . . . no bother to users.

Both sleeves and valves in sizes 4 inches through 12 inches.

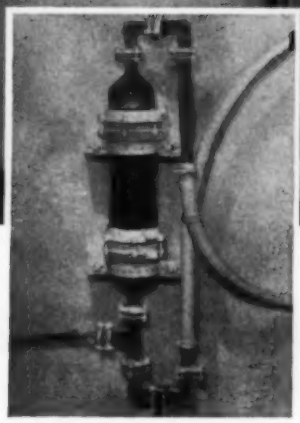
EDDY VALVE COMPANY

A Subsidiary of James B. Clow & Sons, Inc.

WATERFORD, NEW YORK



Chlorine dioxide generating installation. Source of chlorine dioxide is Mathieson Sodium Chlorite. Such a generator is extremely easy and economical to install, operate and maintain.



eliminate
unpleasant tastes and odors effectively, economically
with CHLORINE DIOXIDE

Want to insure water that's free from odors and unpleasant tastes? Then use chlorine dioxide to counteract phenols, algae and industrial wastes in your raw water supplies.

Chlorine dioxide effectively oxidizes phenols to inoffensive residues . . . destroys algae and undesirable bacteria.

This method—using safe, easy-to-use sodium chlorite to produce chlorine dioxide—provides a convenient, effective, economical means of purifying water supplies. It removes iron and manganese. In many cases it eliminates the need for carbon and ammonia in water treatment. And, unlike breakpoint or superchlorination, this method requires little control or supervision.

Get full technical information about water purification with chlorine dioxide produced from Mathieson Sodium Chlorite. Mail the coupon today.

OLIN MATHIESON CHEMICAL CORPORATION
Industrial Chemicals Division
Baltimore 3, Maryland

Please send me technical information about Mathieson sodium Chlorite as a source of chlorine dioxide for use in municipal water treatment.

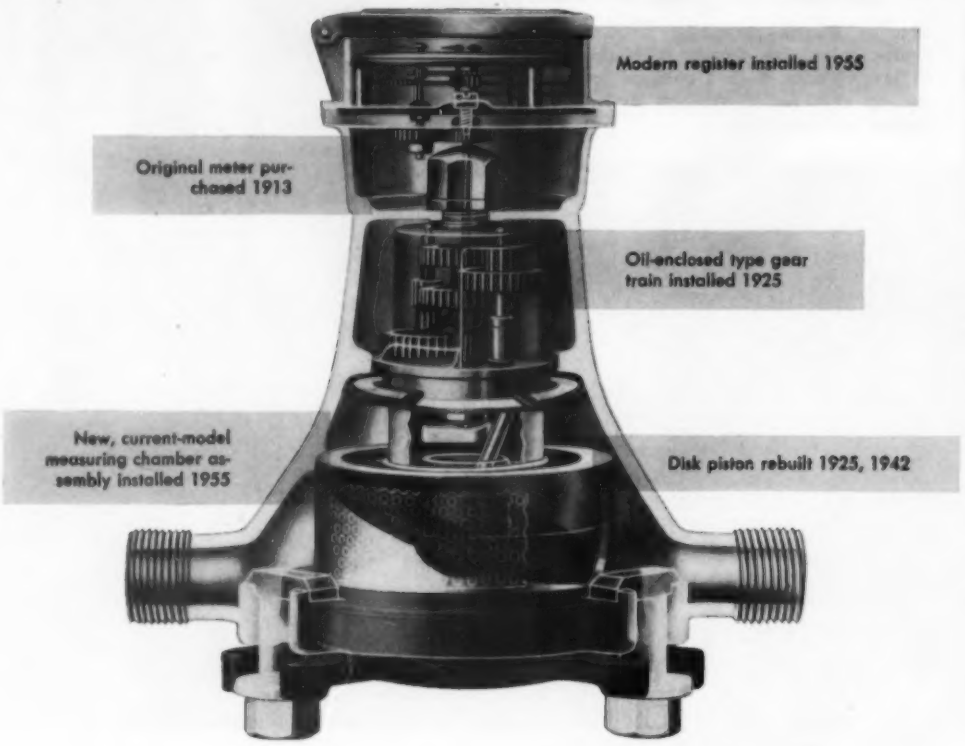
Name_____

Title_____

Address_____

_____

3862


Modern register installed 1955
Original meter purchased 1913
Oil-enclosed type gear train installed 1925
New, current-model measuring chamber assembly installed 1955
Disk piston rebuilt 1925, 1942

How NEW is this Meter?

It was built in 1913 . . . but it's almost as new as 1956. Over the years, working parts have been replaced. Its performance matches every standard of modern metering practice.

The parts used to repair this meter at its last overhaul are identical to those used in the latest Trident meters. They embody every thoroughly tested advancement known to the science of metering.

Designing modern parts to fit "old" meters has been a rigid Neptune policy for over 50 years. It is just one of the extra advantages that make Tridents a better buy . . . both for today and for the years to come.

274

NEPTUNE METER COMPANY
19 West 50th Street, New York 20, N. Y.

NEPTUNE METERS, LTD.
1430 Lakeshore Road, Toronto 14, Ontario

Branch Offices in Principal American and Canadian Cities.

neptune

WATER & SEWAGE WORKS

VOL. 103, NO. 4 • A Scranton Gillette Publication • APRIL, 1956

BENEATH AND A'TOP Chicago's Michigan Blvd.—Installation of 24-in. mechanical jointed supplemental cast-iron lines—late 1955

Another Link in Chicago's Water Works Improvements

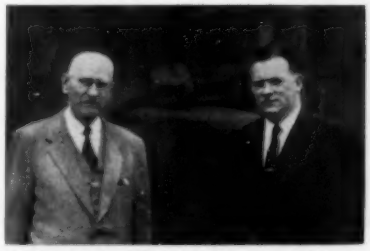
by DEWEY W. JOHNSON

Mr. Johnson is Senior Research Engineer for the Cast Iron Pipe Research Association, Chicago, Ill. He highlights Chicago's "Five-Year Program" of water supply improvements, while devoting especial attention to a major up-grading of water mains under far-famed Michigan Boulevard.

CHICAGO'S Department of Water and Sewers has developed an extensive program of water works improvements covering a five-year period. The construction program was planned to serve both the city and the surrounding suburbs, to improve pressure conditions, to insure ample fire protection, and to have more water available for the hot dry weather months.

The Five-Year Program

This "5-year plan" calls for the spending of more than $154,000,000 on water works facilities. The major undertaking is the construction of the new Central District Filtration Plant, estimated to cost some $68,000,000; also two large water tunnels, $30,000,000; a ground water reservoir on the south side of the city, $2,000,000; feeder mains, and a good number of small main extensions throughout the city, totaling $32,000,000; rehabilitation of pumping stations and equipment, $22,000,000—in all some $154,000,000 worth of improvements.



COMMISSIONER of Water and Sewers, James S. Jardine (right), and W. W. DeBerard, Ass't. Comm. of Water and Sewers

The construction forces have just completed the installation of another link of a new 24-inch feeder main along Michigan Boulevard as a part of the program. This world-famed thoroughfare serves the aristocracy of the mercantile district of the Chicago Loop, and has an unrestricted view overlooking Grant Park and Lake Michigan. The recent building of two large structures required the relocation and redesign of the water distri-

WORLD'S LARGEST filtration plant which has supplied as much as 475 mgd to Chicago's South District, is being out-distanced by the $68,000,000 Central District filtration plant under construction

bution facilities throughout the area. First, the building of the world's largest underground garage by the Chicago Park District, and second, the erection of the Prudential Office Building, the newest and highest skyscraper in Chicago. This imposing building is seen in one of the accompanying photographs looking up the avenue.

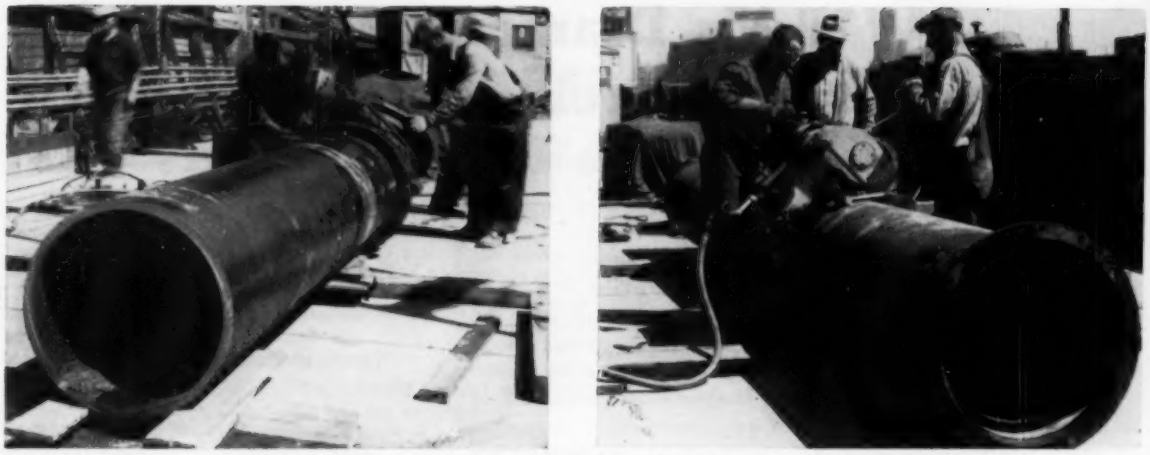
The excavation for the underground garage occupies all of the space under Michigan Boulevard between Randolph Street on the north and Monroe Street on the south, along with a good section of area underneath Grant Park. It is a two-level garage with space for 2,359 cars and a floor area of 873,000 sq ft. The construction of this underground garage necessitated removal of all existing utilities from the area and their relocation along the west wall of the garage and outside of the sidewalk space. This change of utilities constituted a major operation, requiring the relocation of an 84-inch sewer, a 20-inch gas main, a 6-inch gas main, a 16-inch water main and an 8-inch water main, along with several ceramic telephone and electric power ducts.

CHICAGO'S water system, showing location of tunnels, lake intake cribs, pumping stations and filtration plants

A New 24-Inch C. I. Main

A new 24-inch, class 250, mechanical joint, cast-iron water main was installed to replace the two existing mains under the street. In the past the west side of the street had been serviced by an 8-inch main laid in 1883 and the east side by a 16-inch main laid in 1935 with 12-inch inter-connecting mains at 300-foot intervals. Now, the new 24-inch main will carry the entire load. It has been necessary to install the 24-inch main in a piecemeal fashion in order to avoid conflict with other utilities and to work in harmony with a large number of contractors employed on the job. At each end of the underground garage a 16-inch main is carried across Michigan Boulevard to re-connect with the existing system.

The construction of the Prudential Office Building added further water requirements in this area and the 24-inch main has now been extended north under Michigan Boulevard to inter-connect at Lake Street with an existing main, and has also been extended at the south end to connect



MAIN LAYING operations: (Right) cutting 24-in. mechanical-joint C. I. pipe with Wach's air-driven pipe cutter, a Chicago invention; (left) assembly of clean-cut pipe and fittings

with an existing 24-inch main at Adams Street. The 24-inch main at the corner of Adams and Michigan was installed in 1898 and extends south along Michigan and gradually increases in size until at the junction of Polk Street it is 48 inches in diameter. The schedule for improvements calls for the further extension of this 24-inch main north from Lake Street along Michigan Boulevard to the Chicago River. There is a tunnel under the river containing one 24-inch main and at a future date it is planned to increase the capacity of this river crossing, and extend a large main north from the river to tie in with the feeders coming from the Chicago Avenue Pumping Station.

The Prudential Insurance Company of America, whose mid-America home office is situated on Randolph Drive east of Michigan Boulevard, has two 12-inch service connections and a third is being installed for emergency service. The skyscraper (see photo) is 41 stories high, cost over $40,000,000, and when fully occupied will provide working space for more than 9,000 people with an estimated daily water use of 1 million gallons, without considering water for air conditioning which will be supplied directly from the Chicago River through their own facilities.

Pumping Stations

Eleven pumping stations, with a total of 52 pumps, force the water through the city mains. These pumps lift more than 1,000 mgd from the underground supply tunnels from Lake Michigan, and force it into the 4,000 miles of pipeline for delivery to the customer. The pumping pressure moves the water in an endless flow across the city and lifts it to heights of 115 feet. Large mains feed water into smaller mains, small mains spread into branching lines, and finally connect to the service pipes at the consumer's front door. In some of the stations the pumps are driven by electric motors; in others steam turbines or triple-expansion steam pumps are used.

Distribution System

Chicago's vast distribution system covers the city with a network of pipes, which, if placed end to end, would extend across the United States from east to west. Almost every street in Chicago on which a house is located has a city water main within the street, and fire hydrants close enough for fire protection. A 24-hour a day delivery service is maintained to reach 458,484 homes, schools, factories and other service outlets. Along the delivery route, the network stands by ready to supply the Fire Department with water from 43,954 fire hydrants. At the city limits, large mains deliver water to supply 51 suburban communities. Day and night, the consumer gets as much as he needs—for home use, for industrial processes, for power plants, for sprinkling, for air conditioning, and for fire fighting. The following is a summary of pipe making up the distribution system:

Cast-iron	3,997.30 miles
Steel	8.01 miles
Concrete	10.07 miles
Lead	0.27 miles
Total	4,015.65 miles

South District Filtration Plant

Chicago's South District Filtration Plant, placed in full operation in 1947, is the world's largest plant for the filtration of water. It is composed of a low-lift pumping station, three chemical mixing basins, three settling basins, eighty filters, two filtered water reservoirs, a chemical building, laboratories, administration building, shops, and a garage. A goodly portion of the South Side area of the city served by the plant is shown as the shaded area in the accompanying plat. It filters the water for three South Side pumping stations (68th Street, Roseland and Western Avenue). The average pumpage of these stations for 1954 was 352 mgd. The maximum amount of water filtered in 24 hours in 1954 was 478 million gallons. The plant serves 1,350,000 people.

A Bargain in Public Service

The public takes for granted that when they turn on a faucet they will get an unlimited supply of water. They do not recognize the continuous efficient service performed day and night by public employees that makes this possible. Only when something goes wrong with this vital service does the public realize its dependence on their water utility. Neither do they realize that this most essential commodity comes to them at "bargain basement" rates. Compared with other major cities in the United States, Chicago furnishes the lowest cost water. It is delivered to the consumer at the approximate cost of $0.03 per ton.

The work in connection with the supervision of operation and maintenance and the sanitary quality of the Chicago public water supply is carried on by the Department of Water and Sewers. Mr. James W. Jardine is Commissioner of Water and Sewers. Mr. W. W. DeBerard is Deputy Commissioner for Water and Sewers and serves as Chief Water Engineer.

AWWA's Diamond Jubilee Convention Technical Program

Keil Auditorium, St. Louis, Mo., May 7-10, 1956

Monday, May 7 — A.M.

WATER WORKS ADMINISTRATION COMMITTEE
(Open Session)

Task Group Report — NARUC Rules, Regulations—*John Murdoch*
Task Group Report — Rules and Regulations of the California Commission—*W. C. Welmon*
Task Group Report — Job Classification—*Robert Millar*
Task Group Report—Rating Water Systems—*John Murdoch*
Survey of Mobile Radio Use — 1955—*M. B. Cunningham*
Other reports to be scheduled

WATER PURIFICATION DIVISION

Calcite Stabilization of Lime Softened Water—*H. O. Hartung*
Discussion—*V. J. Calise*
State Sanitary Engineer Manual — Plans for Public Water Supplies
Panel Discussion —
Water Treatment Section—*Philip Morgan*, Moderator
Task Group Statement—*W. W. Aultman, E. H. Aldrich*
Discussion—*C. W. Klassen*

Monday, May 7 — P.M.

WATER PURIFICATION DIVISION

New Algaecides—*C. M. Palmer*
Economics of Sludge Removal—*F. G. Gordon*
Coliform Limits for Raw Waters—*Graham Walton*
Diatomite vs. Conventional Filter Performance—*G. R. Bell*

JOINT SESSION, RESOURCES AND MANAGEMENT DIVISIONS

St. Louis Area Water Supply Developments—*T. J. Skinker*, Moderator
Water Resources of the Area—*T. J. Skinker*
Water Resources Development on the East Side of the Mississippi River—*S. C. Casteel*
Water Resources Development for the City of St. Louis—*J. B. Dean*
Water Resources Development in St. Louis County—*W. V. Weir*
Water Quality and Treatment Requirements—*W. B. Schworm*
Shall Recreational Uses of Water Supply Impounding Reservoirs be Permitted?—*R. B. Diemer, M. L. Riehl, Alexander Minkus*

Tuesday, May 8 — A.M.

JOINT SESSION, MANAGEMENT AND RESOURCES DIVISIONS

The Status of Federal Highway Legislation—*Paul Weir*
The Nation's Water Resources—*Douglas McKay*
The Missouri River — Panel Discussion—*J. W. Cramer*, Moderator
Effect Upon the Total River Flow of Present and Probable Future Operation of Main Stem Dams—*Wendell Johnson*
Recent Changes and Trends in Quantity and Quality of Missouri River Water and of Ground Water in the Immediate Vicinity of the River—*G. E. Ferguson*
Present Conditions and Trends in the Pollution of the River—*D. F. Metzler*
Experiences and Observations of the Water Utility Executive—*J. C. Detweiler, J. B. Ramsey*

Tuesday, May 8 — P.M.

WATER WORKS PRACTICE COMMITTEE
(Open Session)

Progress Report: Meter Standards—*J. G. Carns*
Research Report: Effect of Water Treatment Methods on Water Main Carrying Capacity—*T. E. Larson*
Research Report: Toxicity Studies on Cadmium and Chromium in Public Water Supplies—*C. F. Decker*
General Policy Committee Report: Conformance to Standards—*M. B. Cunningham*

WATER RESOURCES DIVISION

Water Demand Potential of Irrigation in Humid Areas—*J. R. Davis*
Evaluation of Weather Modification Experiments—*S. A. Berry*
Resources Section — Panel Discussion
Manual of Design of Public Water Supplies — Task Group Report—*L. J. Alexander, S. B. Nelson*
Discussion—*B. A. Poole*

Wednesday, May 9 — A.M.

WATER DISTRIBUTION DIVISION

Control of Booster Stations to Serve Secondary Areas—*Marvin Owen*
Centralized Load Dispatching Experience—*J. M. Jester, J. W. Henderson*
Problems in Purchase of Water: Demand or Penalty Rates—*V. C. Lischer*
Surge Control on Transmission Lines of the St. Louis County Water Company—*F. E. Dolson, H. O. Hartung*

WATER WORKS MANAGEMENT DIVISION

Management Reorganization of the Philadelphia Water Department—*Samuel Baxter*
Modernizing the Metering Program of the Philadelphia Water Department—*G. E. Arnold*
How Meters Help Increase Revenue—*Wentworth Smith*

Wednesday, May 9 — P.M.

DIVISION BUSINESS MEETINGS IN PARALLEL

(Discussion of Sanitary Engineers Manual of Design)
Management Division—*Paul Haney, M. P. Hatcher, F. Metzler*
Distribution Division—*R. G. Kincaid, L. S. Finch, Earl Devendorf*

Thursday, May 10 — A.M.

GENERAL SESSION

Seventy-Five Years of Improvement in Water Supply Quality—*Abel Wolman*
Seventy-Five Years of Progress in Materials and Construction—*E. S. Chase*
Seventy-Five Years of Too-Cheap Water—*John Murdoch*

Thursday, May 10 — P.M.

WATER DISTRIBUTION DIVISION

Behavior of Steel Pipe Under Earth Loads—*R. E. Barnard*
Application of Soil Mechanics to Pipeline Construction—*Henry Reitz*
External Corrosion Problems in the Water Distribution System—*L. P. Sudrabin*

WATER WORKS MANAGEMENT DIVISION

Service Requirements of Water Connected Devices—*J. G. Carns*
Galvanic Corrosion in Water Meters—*H. F. Barrett*
Studies in Water Use—*Kenneth Shull, George Dann*
In-Service Training Program of the Philadelphia Suburban Water Company—*George Dann, Kenneth Shull*

Introduction to Basic Radiological Health For Water Works Personnel

by DAVID H. HOWELLS

Mr. Howells is Senior Assistant Sanitary Engineer, U. S. Public Health Service. This article, based on a talk given before the 1955 Illinois Water Plant Operators' Conference, is designed to provide an elementary knowledge of radioactivity and to present the latest authoritative information on fallout hazards and the removal of radioactive materials from water by conventional water treatment processes.

EACH NEW STEP in the development of the science of water treatment, from the open spring to the most modern rapid sand filtration and softening plants, has brought with it the need for the operator to improve his knowledge of the sciences which he must apply in the operation of his particular plant. He has found it necessary to learn enough chemistry, bacteriology, aquatic biology, and hydraulics to provide the desired quality of water. Rarely has he had to develop a full professional competence in these fields, but rather a working knowledge commensurate with the problems he must solve.

We are now in the midst of what is, perhaps, the greatest single scientific development of mankind. The atom has been harnessed and we are faced with the problem of knowing enough about radioactivity to enable us to recognize potential and actual hazards in water supplies from pollution with radioactive materials.

The increased use of radioisotopes in the past few years has resulted in a similar increase in the discharge of these materials to the environment. As a result of inquiries directed to more than 1,000 users of radioisotopes in 1952, it was found that about 41 per cent of these disposed of their radioisotopes by dilution and discharge to the sewers[1]. The amounts of radioactive materials used in the future undoubtedly will increase manyfold over the amounts employed now. This increased use will result in the release of greater amounts and variety of radioactive materials to watercourses.

Obviously, this is a science with which water works personnel must have a speaking acquaintanceship.

Structure of the Atom

The atom has often been defined as the simplest unit of an element which participates in a chemical reaction. It cannot be broken down by ordinary means, but it will break up into smaller particles when bombarded with high-energy particles like those coming from radioactive materials or those produced by particle accelerators.

The atom consists of two main parts, termed the nucleus and the electron cloud. The nucleus is the central portion of the atom. It is not a single particle, but is made up of protons and neutrons. Protons and neutrons are elementary nuclear particles of approximately equal mass. The proton has a positive electrical charge numerically equal to the negative charge of the electron. The neutron is electrically neutral. The neutrons and protons are held together in the nucleus by some force sufficiently great to overcome the force of repulsion that exists between the positively-charged protons. This is called the "binding energy." The electron cloud surrounding the nucleus of the atom contains the electrons which are in motion about the nucleus. These electrons are negatively-charged particles with a mass approximately 1/1800 of that of the protons or neutrons.

The atom can be compared to the planetary solar system, in which the planets revolve about the sun as a nucleus. Like the planets in a planetary solar system, the electrons in the atom rotate about the nucleus in paths termed orbits. Regardless of the motion of the individual electrons, it has been established that the electrons of an atom are grouped in well-defined orbits, or shells, which are called energy levels.

The energy possessed by the electrons becomes greater with increasing distance away from the nucleus. There is a great deal of empty space in any shell and between shells, but the moving electrons create a dense electrical field about the nucleus. This field created by the orbital electrons is opposite in nature to the field produced by the nucleus, because the nucleus contains positively-charged components while the electron cloud is made up of negatively-charged electrons.

In a neutral atom, the electrical fields are balanced and the charge is zero. The force of attraction between the negatively-charged electrons and the positively-charged nucleus is just balanced by the centrifugal force due to the whirling motion of the electrons around the nucleus. As a result, the electrons perpetually rotate about the nucleus in the frictionless void of the atom. When the number of protons in the nucleus and the number of electrons in the electron cloud are not balanced, the atom is called an ion.

Before attempting to construct the atom from its components, it will be necessary to define a few things in order that the nuclear terminology may be used.

A general expression used in the texts on atomic structure is ${}_{Z}X^{A}$. The X term in this expression represents the symbol of the element. These symbols already are familiar, as they are used in everyday chemistry. Examples are Ca, Mg, Na, and Fe. The other two terms, however, will be defined and should be committed to memory. They are fundamental and must be understood.

Atomic Number (Z)

The symbol Z indicates the atomic number of the element, and also equals the number of protons in the nucleus of an atom. Since normal atoms are electrically neutral and one electron can neutralize one proton, the atomic number also equals the number of electrons outside the nucleus in the electron cloud. There are 101 elements, 101 symbols, and 101 atomic

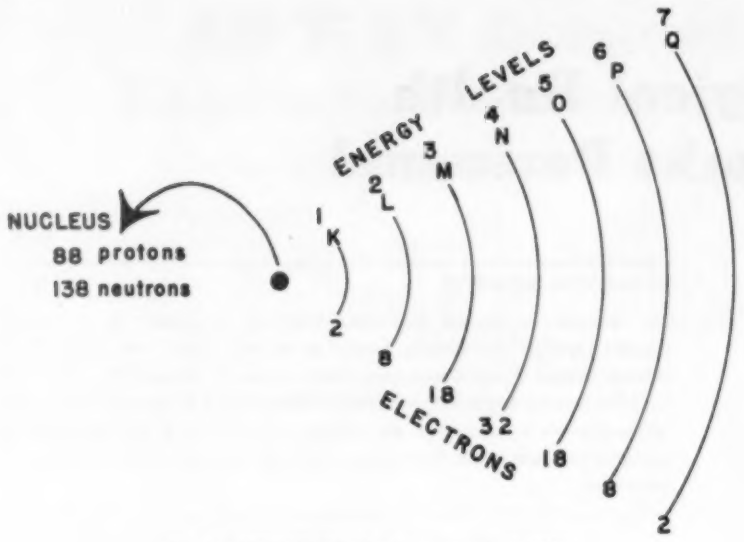


Fig. 1—STRUCTURE of radium atom ($_{88}Ra^{226}$)

numbers. Consequently, there is only one number and only one symbol for each element.

Mass Number (A)

The symbol A is the mass number, and is equal to the sum of protons and neutrons in the nucleus of the atom. To find the mass number of an atom, look in the Periodic Chart or Table of Atomic Weights and take the whole number nearest the atomic weight listed. As an example, the mass number for chlorine, which has an atomic weight of 35.457, is 35. Unlike atomic numbers, an element may have more than one mass number. This will be explained in a moment.

Neutron Number (A — Z)

The number of neutrons in a nucleus can be obtained by subtracting the atomic number, Z, from the mass number, A. For instance, for an element such as zinc, which has a mass number of 65 and an atomic number of 30, the number of neutrons would be 65 — 30, or 35.

With the help of a table of atomic weights, it is possible to determine the structure of an atom such as radium. As an example, this table reveals that the atomic number of radium is 88 and the atomic weight 226.05. This means that the mass number is 226 and the expression $_{Z}X^{A}$ becomes $_{88}Ra^{226}$, showing that there are 88 protons and 226 — 88, or 138, neutrons in the nucleus, and 88 planetary electrons in the electron cloud of the radium atom. It was stated earlier that the planetary electrons in the electron cloud of an atom are arranged in well-defined energy levels or shells. In an atom of radium, the electrons are arranged as shown by Fig. 1. It will be noted that the different energy levels are designated both numerically and alphabetically.

Atoms can contain anywhere from one to seven electron shells. If all seven shells are filled to capacity with electrons, there would be 280 elements. Since there are only 101 elements known at present, there must be less than the maximum number of electrons in the various shells. No elements have been found in nature in which the 5th, 6th, or 7th shells contain their maximum number of electrons. There is also reason to believe that the outer shell of an atom never contains more than eight electrons, regardless of whether the atom is in the free or the combined state. The electrons in the outer shell are called the valence electrons; they determine the chemical properties of the atom.

All atoms in their natural state have the same number of electrons as protons. Consequently, they carry no residual electric charge. When atoms combine to form compounds, the resulting molecule has the same total number of electrons as it does protons; the molecule is also electrically neutral. Since the electron is the lightest part of the atom and each electron is not bound as tightly to the nucleus as the protons and neutrons are bound to each other in the nucleus, the electron is more mobile and can be removed from an atom or molecule without expending much energy. When an electron is removed from an atom or molecule, the portion of the atom or molecule remaining becomes electrically charged, because the protons are then in excess of the electrons.

This electrically-charged particle resulting from the removal of an electron from an atom is called an ion. Ions may be charged positively or negatively. Positive ions are produced by removing electrons from neutral atoms or molecules and are known as cations, because in the electrical field they are attracted towards the negative pole or cathode. Examples are Ca^{++}, Mg^{++}, and Na^{+}. Negative ions are created when electrons attach themselves to neutral atoms or molecules. Examples are Cl^{-}, CO_3^{-}, HCO_3^{-}, and $PO_4^{\equiv}$. The magnitude of the electrical charge on the ion, in terms of electron units, is equal to the number of electrons removed from or added to a neutral atom or molecule. The charge on an ion in terms of electron units is called the valence of the ion. Recently it has become common practice to consider an electron as an ion. *Ions* are, therefore, defined as free electrons or atoms or groups of atoms carrying an electric charge.

Ionization is the process of producing ions. Anything capable of causing the removal of electrons from or their addition to neutral atoms or molecules is capable of causing ionization. In the field of radiation, the ionizing events are more frequently the removal of electrons. Consequently, the ionizing event is spoken of as producing an ion pair — the electron which is removed and the positive ion remaining.

If an atom is bombarded with very high energy electrons, an electron in the K shell may be knocked out, creating a vacancy, and one of the outer electrons will jump down into the vacant spot to fill it up. In jumping down, energy is liberated from the electron in the form of an X-ray, and this is the way X-rays are formed. The electrons of atoms of different elements are bound to their respective nuclei with different energy, and the energy of the X-rays given off will depend upon the element producing them.

In general, the ability of a particle to cause ionization depends upon the nature of the particle, such as its velocity, mass, and charge, and the state of the medium which it traverses.

From the viewpoint of the biologist or physician, the phenomena of ionization are of the greatest importance, since it is the ionizing event that serves to initiate the complex series of reactions that characterize radiation damage to living tissue. It should be remembered that, for any penetrating radiation to cause primary damage to living tissue, it must produce ionization within the tissue.

As previously pointed out, each element has only one atomic number, Z, but may have more than one mass number, A. When an element exists in more than one form, each of which differs from the other only in the mass number, these forms of the element are spoken of as isotopic forms, or they are said to be isotopes of each other. Therefore, *isotopes* are elements with the same atomic number, but different mass number. Isotopes differ only in the number of neutrons in the nucleus. There are three natural isotopes of oxygen; namely, the 16, 17 and 18 species, which may be written ${}_8O^{16}$, ${}_8O^{17}$, and ${}_8O^{18}$.

Hydrogen has three isotopes, hydrogen 1, 2, and 3, which may be called hydrogen one (protium), deuterium, and tritium, and written ${}_1H^1$, ${}_1H^2$, and ${}_1H^3$, respectively. Each of these isotopes differs by the number of neutrons in the nucleus; ${}_1H^1$ has no neutrons, ${}_1H^2$ has one, and ${}_1H^3$ has two. Hydrogen one is the common isotope; ${}_1H^2$ is spoken of as heavy hydrogen, and is the form present in heavy water. Some elements have a large number of isotopes and others have only a few. Tin, for example, has nineteen.

Radioactivity

Powerful forces tug at the protons and neutrons in the nuclei of atoms. Some of the forces act to keep the nuclear particles together, and these have been referred to earlier as *binding energy*. Other forces tend to force the nuclear particles apart. This group includes the electrostatic force of repulsion existing between the positively-charged protons. In some isotopes, these forces are in balance and atoms are considered stable. In others, the forces are not so well balanced, and the nuclei undergo spontaneous rupture, ejecting charged particles, or gamma photons, in order to attain a greater stability within their nuclei. These isotopes are unstable; their nuclei are said to undergo radioactive decay; and they are called radioactive isotopes. The emission of alpha or beta particles from the nucleus of an atom is called particle radiation. Some forms of nuclear radiation are not associated with particle motion, but rather through wave motion called gamma rays.

Alpha Particles

Alpha "rays" are actually particles. They are the least penetrating of the three types of radiation, and can be absorbed or stopped by a few centimeters of air or a thin piece of paper. They have a positive charge exactly twice that of a proton, and a mass number of four, the same as the nucleus of the helium atom. The symbols used to designate alpha particles are the Greek letter alpha (α) or ${}_2He^4$, where 2 is the atomic number and 4 the mass number.

Beta Particles

Beta "rays" are also particles. They have the same mass and charge as an electron and, thus, are simply high-speed electrons. They arise from neutrons in the nucleus of the radioactive atom, in contrast with ordinary electrons, which originate in the orbits around the nucleus. The neutron, losing a negative electrical charge and only negligible mass, is transformed into a positively-charged proton. The atomic number is increased one unit for each loss of a beta particle, because of the simultaneous gain in the number of protons. The mass number is unchanged. The beta particles travel several hundred times the distance traveled by alpha particles in air, and require a few millimeters of aluminum to stop them. The symbols used to designate beta particles are the Greek letter beta (β^-) or ${}_{-1}e^0$.

Gamma Rays

Gamma rays are electromagnetic radiation. Electromagnetic radiation has no mass—a beam of electromagnetic radiation appears to consist of an immense number of little packets of energy called photons, each traveling with the speed of light. Common forms of electromagnetic radiation are radio waves, heat, visible light, ultraviolet light, X-rays, gamma rays, and cosmic rays.

The energy content of the photons of these different forms of electromagnetic radiation varies considerably. Sometimes, when the massless photons get intimately involved with a single atom or atomic nucleus, they disappear and new mass appears. Thus, although protons do not exhibit mass, they do have a mass equivalence for their energy. This is expressed in Einstein's energy-mass equivalence formula:

$$\text{Energy} = \text{mass} \times \text{constant, or } E = m c^2$$

The symbol for gamma radiation is the Greek letter gamma (γ).

For convenience in discussing the energies of radiations, a special unit, the electron volt, is used. One electron volt (e.v.) is the energy given a single electron as it moves across an electric potential difference of one volt. Energies of ionizing radiations, such as alpha and beta particles or gamma photons, can range from a few thousand up into the millions of electron volts. A million electron volts constitute enough energy to lift one pound about one trillionth (0.000000000001) of an inch. Mass, which is closely akin to weight, is expressed in mass units. A mass unit is equal to one-sixteenth of the atomic weight of the common isotope of oxygen.

Natural Radioactivity

Natural radioactivity occurs spontaneously in nature, and is not affected by any temperature or pressure produced on earth. The naturally occurring radioisotopes are frequently alpha emitters, whereas the artificially radioactive substances are almost all beta emitters. Any particular radioactive atom is either an alpha emitter or a beta emitter. It cannot be both, but it can emit gamma radiation simultaneously with its particulate emission.

An example of natural radioactivity is the decomposition of radium to radon. This is shown as follows:

$${}_{88}Ra^{226} \rightarrow {}_{86}Rn^{222} + {}_2He^4 + \gamma + \text{Energy}$$

Radon is also unstable and proceeds to decay to still another radioactive element.

All the natural radioactive elements can be grouped into three major series of elements, the uranium, thorium, and actinium series. Such a sequence of unstable elements is called a radioactive series, or family. Elements in these series decompose through intermediate radioactive elements, finally to form stable lead.

In addition to the activity found in naturally occurring radioactive elements, the earth is being bombarded continuously by radiation originating in outer space. This radiation, in passing through the earth's atmosphere, produces many other types of radiation, which are collectively known as cosmic radiation or cosmic rays. This cosmic radiation accounts for about 70 per cent of what is known as background count.

Artificial Radioactivity

If a nucleus of an atom is subjected to bombardment by neutrons or by charged particles, such as protons or alpha particles, which have been artificially accelerated to high velocities, it is possible that some of the bombarding particles will collide with the target nuclei, and a nuclear reaction may occur.

In some instances, the nucleus of the target material may be simply "excited" by the bombarding particle, and it may return to its normal state by the emission of a photon of appropriate energy. In other cases, the nu-

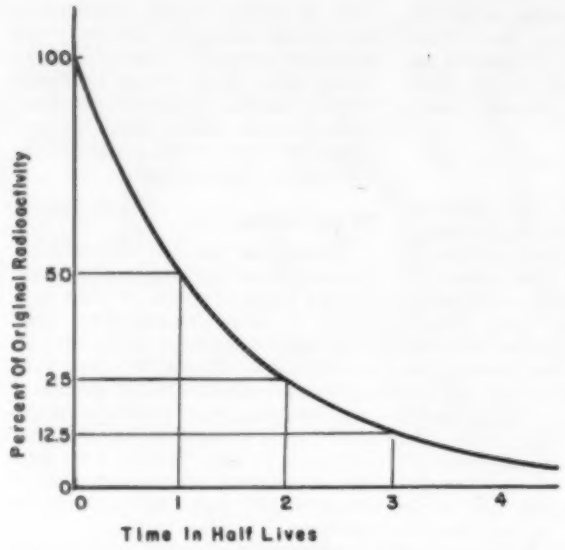


Fig. 2—SIMPLE radioactive decay

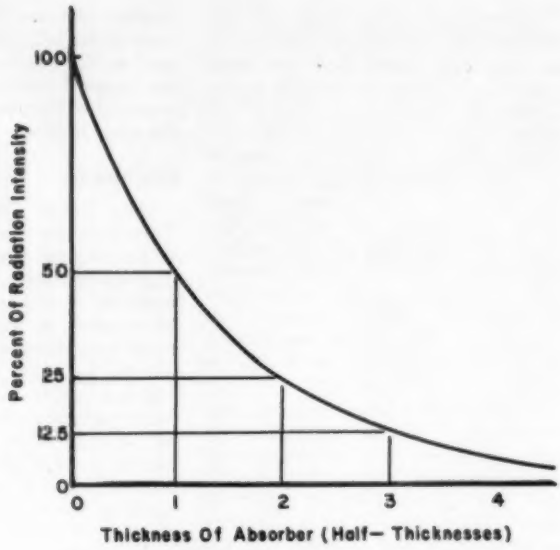


Fig. 3—ABSORPTION of X and gamma radiation

cleus may undergo a radioactive transformation to form an isotope of another element.

In general, substances which are thus made artificially radioactive decay either by emission of gamma rays or by beta decay. An example of the decay of an artificial radioactive isotope is as follows:

$$_{11}Na^{24} \rightarrow {}_{-1}e^{0} + {}_{12}Mg^{24} + \gamma$$

Radioactive Decay

Very early in the history of radioactivity, it was discovered that the activity of the radioactive elements decreased with time. For a given quantity of the element, the activity might decrease markedly in a matter of seconds, or, for a different element, it might be a matter of years. This decrease in activity represents the decay, or decomposition, of the radioactive element into other elements. Radioactive decay can neither be slower nor hurried by any practical means.

It is impossible to say when any particular radioactive atom will disintegrate, but, if a large number of atoms are considered, it is possible to predict the number which will disintegrate within a given time.

If the amount of radioactivity or intensity is plotted against time, for a particular element, a curve is obtained in which the amount of radioactivity approaches, but never quite reaches, zero. This is illustrated by Fig. 2. The rate of change of activity is characteristic for each different radioactive element.

It is convenient to talk about this rate of change in terms of the time required for a given quantity of the substance to decompose until only half of it remains. This is called its *half life*. Half lives of radioisotopes range from fractions of seconds for some to millions or billions of years for others. As an example: N^{12} has a half life of 13/1000th of a second; I^{131}, 8.14 days; and C^{14}, 5,580 years.

Unit of Radioactivity

Much of the early investigations with radioactivity were carried out with radium. As a result, radium was adopted as the international standard for use in measuring the radioactivity of other naturally occurring radioelements and, ultimately, was extended to serve as the standard of measurement of artificially produced isotopes. The unit of measurement adopted was named the "curie," in honor of Pierre and Marie Curie, who performed much of the early investigative work with natural radioactivity, and were the first scientists to isolate radium.

One gram of radium was adopted as the standard of reference, and the radioactivity associated with one gram was designated as the curie.

There are approximately 37,000,000,000 nuclear disintegrations occurring each second in one gram of radium. Thus, the curie can be defined as that amount of any radioactive nuclide in which the number of disintegrations per second is 37,000,000,000. It is a measure of radiation intensity. This term applies to radioactivity in much the same way that the term ampere applies to electricity, or mgd to water supply.

Absorption of Radiation

We are particularly interested in the absorption of radiation because it is the absorption process in certain media that permits us to detect it; absorption in denser media permits us to shield ourselves against it; and the absorption in body tissues results in physiological injury.

Alpha Absorption—Alpha particles are ejected from the nuclei of radioactive atoms with velocities of the order of 1/20th of the speed of light, or 9,300 miles per second. As this relatively massive particle carrying two positive charges proceeds through matter, it removes electrons from the atoms making up the absorbing matter and leaves them strewn in its path. Through ionization, excitation, and nuclear collision, the energy of the alpha particle is expended, and it picks up two electrons, to become a normal helium atom.

The range of the alpha particles is short, and the ionization produced is very dense. The trail of the alpha particle is marked by tens of thousands of ions per centimeter of path length. It is this property of producing heavy ionization in human tissue that makes the alpha particles so hazardous if they are ingested or inhaled and deposited in the body.

Beta Absorption—As mentioned earlier, beta particles are high-speed electrons which originate within the nucleus of a radioactive atom. The beta particles carry only a single neg-

ative charge. They are emitted with varying energies and do not, therefore, travel at the same velocity. They produce about 1/1000th the number of ions produced by the alpha particle, and travel about 1000 times as far.

Absorption of X and Gamma Rays —Absorption of X and gamma rays by ionization is quite different from that of alpha or beta particles. It involves the interaction of the X and gamma photons with orbital electrons and atomic nuclei. X and gamma photons are absorbed in matter in such a manner that an infinite thickness of absorber is necessary to stop all the photons. In other words, the intensity of radiation approaches, but never reaches, zero with increasing thickness of absorber. As an example, if a certain thickness of lead reduces a given X or gamma beam to one-half its original intensity, a similar one twice as thick would reduce it to one-half of one-half, or one-quarter, of its original intensity. This is illustrated by Fig. 3. Any intensity of this type of radiation can be reduced to any desired level if a sufficient thickness of absorbing material is used.

The *roentgen* is a unit used to measure the absorption of gamma and X-rays only. It does not apply to particle radiation. It is an expression of the ability of gamma or X-radiation to ionize air. One roentgen represents quite a large dose of ionizing radiation, and the milliroentgen (mr) or one-thousandth of a roentgen is in common use for purposes of measurement.

Since the roentgen applies only to gamma and X-rays, there was a need for an additional unit to express dosage of the other kinds of radiation. The *roentgen equivalent physical* (rep) is used for this purpose. It can be said that one *rep* is the amount of particulate ionizing radiation whose absorption imparts to living tissue the same amount of energy as does the absorption of one roentgen of gamma or X-radiation.

Measurement of Radioactivity

The detection of particulate and X and gamma radiation requires the use of instruments, since the human senses are not receptive to nuclear radiations as the ear is to sound or the eye to sight.

There are many types of detection instruments designed for specific applications, but all depend upon the ability of nuclear radiations to cause ionization. The medium in which the ionization takes place and the means used to measure this ionization determine the type of instrument. These instruments can be classified according to the principles involved in the operation, such as gas-ionization instruments, photographic emulsions, scintillation phosphors, and chemical dosimeters. On the basis of use, they can be classified as surveying, personnel monitoring, or laboratory instruments.

Fission and Fission Products

Nature provides 92 elements; in the last 15 years, man has produced 9 additional. All the elements with atomic numbers greater than 83 (bismuth) are radioactive. While exhibiting the property of radioactivity, they are converting some of their mass into radiant energy in accordance with Einstein's equation ($E = m c^2$), and are simultaneously transmuting themselves into less massive or more stable elements.

When one considers the magnitude of the square of the velocity of light, which is constant (c) in this equation, the reason for the large amount of energy derived from relatively small amounts of radioactive elements utilized in nuclear reactions becomes readily apparent. This process is slow and releases relatively small amounts of energy for each decay step.

By lobbing a projectile into the nucleus of these radioactive elements, an internal explosion can be made to take place, so that the target nucleus breaks up into at least two other nuclei with a concurrent release of a relatively large amount of energy. The projectile which has worked successfully for this process is a neutron. The explosion is called the *fission* process, and the resulting materials are called *fission products*.

During the fission process, approximately 200,000,000 electron volts of energy are released from each nucleus of uranium or plutonium which is fissioned. In addition to energy and fission products, more neutrons are produced. This provides a means of continuing a chain reaction, once it has started. The products from any single fission will not generally be the same as those for a second uranium or plutonium atom. Therefore, a host of fission products can be expected.

The fission process can be shown by the following equation. This and many similar reactions take place in a short time during the operation of an atomic reactor or the detonation of an atomic bomb.

$$_{94}Pu^{239} + _{0}n^{1} \rightarrow _{40}Zr^{97} + _{54}Xe^{140} + 3_{0}n^{1} + E \text{ (200 Mev.)}$$

Energy is produced by breaking up the larger elements into intermediate-weight elements.

Fusion

It is also possible to fuse light-atomic-weight elements into heavier-atomic-weight elements, with an attending release of energy resulting from the conversion of matter. The activation energy for the fusion process is so great that it requires temperatures equal to that of the sun to initiate the process. It is known that this process is taking place on the sun, and that this is a possible source of the sun's energy.

Now that the atomic bomb has been made and it creates temperatures equal to that of the sun, it is possible to fuse the light elements into heavier ones with more stable nuclei and bring about the further release of energy. In the hydrogen bomb, as in the sun, isotopes of hydrogen, the lightest element known, will be fused together to produce helium; and energy will be produced. Atomic bombs or similar devices using fission processes are required to initiate the fusion process which is utilized in a hydrogen bomb in such a manner that the release of energy is of the order of thousands of times that released by one atom bomb.

Radioactive Fallout

Large nuclear weapons, which produce a fireball several miles in diameter, are likely to be detonated at a height where the fireball touches the ground surface. The probability of widespread contamination, by the fallout of radioactive material, will then be much greater than in the case of earlier bombs or detonations, when the fireball did not intersect the surface. Radioactive debris from a thermonuclear explosion whose fireball intersects the surface consists of material ranging in size from extremely fine dust particles, which settle very slowly, to large particles picked up from the ground beneath the point of detonation, which fall back to earth within a few minutes. Thus, the fallout of radioactive particles, which begins soon after detonation, continues indefinitely. In order to predict the area where significant fallout is likely to occur, currently observed wind data from the surface to 80,000 feet are required.

Following the test explosion at Bikini on March 1, 1954, there was sufficient radioactivity in a downwind belt about 140 miles in length and of varying width up to 20 miles to have seriously threatened the lives of nearly all persons who might have been in such an area and who did not take protective measures. About 7,000 square miles of territory downwind from the point of burst were so contaminated that survival might have

depended upon prompt evacuation of the area or upon taking shelter and other protective measures[2].

Contamination of public water supplies through radioactive fallout is a potential threat to the communities whose water supplies are located in the downwind areas from critical targets, especially if the water supplies are held in open storage areas. However, in comparison to the external hazard from fallout, the internal hazard from contaminated drinking water would initially be inconsiderable.

The greatest possibility of internal exposure hazard could occur some time after fallout, when environmental exposures had been reduced, but processes of solution and watershed concentration had accumulated the longer-lived radioisotopes in water storage basins. (Current studies, although limited in their extent, appear to show that long-term contamination may be a remote possibility.) At that time, thought might have to be given to development of a new supply or to treatment of existing supply.

Removal of Radioactive Materials by Conventional Water Treatment Processes

There is considerable misunderstanding on the part of the engineering profession on the value of water treatment processes for the removal of radioactive material.

Originally, it was thought that conventional coagulation, settling, filtration, and some of the other water treatment processes would be effective in the removal of specific radioactive materials. Experience in the laboratory, however, has not borne out this optimism[3].

In the first place, it must be remembered that radioactive and stable isotopes of an element behave in the same way during chemical and biological treatment. Thus, if the conventional process is not designed to remove a specific element, there is no reason to believe that the process will remove the specific radioisotope. Radioactive calcium, barium, or strontium, for example, will be significantly removed by softening, since the purpose of softening is to remove calcium. Barium and strontium will be removed with calcium because of their similar chemical properties[3].

The efficiency of conventional water treatment processes for the removal of radioactive contaminants must be geared to the maximum permissible concentration values. These values represent the best available information on permissible concentrations of radioactive materials in water, and were derived on the assumption that the contaminated supply is the sole source of supply during the lifetime of an individual (taken as 70 years). They may be used to calculate the degree of removal that must be provided to meet these levels when the nature and amount of activity initially present are known[1].

Conventional water treatment processes will be useful only in those cases when the levels of radioactive materials are relatively low, certainly in the microcurie (millionth of a curie) per liter range. As an example, Sr^{89} could not be discharged into a source of water supply in concentrations exceeding 0.0001 microcuries per milliliter (0.0000000034 ppm) if the removal efficiency of treatment were 75 per cent and the maximum permissible concentration of 0.00007 microcuries per milliliter in the finished water were not exceeded[1].

With the exception of most cations of valence 3, 4, or 5, coagulation and settling have not been very effective for the removal of radioactive materials from water. Iodine 131, an anion, cannot be removed by coagulation with alum or iron. However, the addition of small amounts of activated carbon, copper sulfate, or silver nitrate has been found to increase the removal of this anion to about 96 per cent. Sand filters, except for removal by simple straining or adsorption on biological life contained on the surface of the filter, have not been effective. Their major function is to remove the radioactivity previously incorporated in floc particles[1].

Softening with lime and soda ash, under proper conditions, may give effective removals of some cations. Removals of 95 to 99 per cent have been accomplished. For most satisfactory removals, excesses of both lime and soda ash are required[1].

Removal of radioactive materials by ion exchange is technically possible. For most effective removal, mixed bed or cation and anion exchange beds in series are recommended. Waters to be treated should be low in dissolved solids if adequate removals and economic operation are to be obtained[1].

In summary, laboratory studies have shown that conventional water treatment processes may remove varying percentages of radioactive contaminants from water. The percentage values have little meaning, however, unless they are related to the initial concentration of the radioactive materials present and to the maximum permissible concentration value prescribed for the individual radioisotope. In general, unless the initial concentration is very low, water treatment processes will be ineffective for reducing radioactive contaminants to acceptable safe limits.

References

1. Straub, Conrad P., "Limitations of Water Treatment Methods for Removing Radioactive Contaminants." Public Health Reports, 70, No. 9 (Sept., 1955).

2. Anon., Federal Civil Defense Administration Advisory Bulletin No. 179 (Feb. 9, 1955).

3. Anon., "Sanitary Engineering Aspects of Nuclear Energy." Progress Report of the Committee of the Sanitary Engineering Division on the Sanitary Engineering Aspects of Nuclear Energy, Amer. Soc. of Civil Engrs., ASCE Separate No. 646 (Mar., 1955).

4. Unpublished course material prepared by the Radiological Health Training Group, Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio.

5. "Radiological Health Handbook." U.S. Public Health Service.

R. W. Sparling Sr. Dies of Heart Attack

Raymond W. Sparling, founder and president of the Sparling Meter Co. of Los Angeles, died on February 5th as the result of a coronary heart attack. He was in his 69th year.

A native of Port Huron, Mich., he had lived in California for 60 years. He was the inventor of the well-known Sparling Turbine Meter and established the R. W. Sparling Meter Co. some 40 years ago. He had only recently passed the active management of the company over to his son, "Ray" C. Sparling.

Mr. Sparling resided in South Pasadena, was a member of Los Angeles Chamber of Commerce, the California and the National Chambers of Commerce, and the Merchants' and Manufacturer's Association, the American Water Works Association and the Water and Sewage Works Manufacturer's Association.

"R. W." had a host of friends and admirers in the water works field who

long ago learned to associate the man with his product. The industry has lost a sterling character.

WATER WORKS PRACTICES

Filtration — Part 2*

The Twenty-Ninth of a Series

by GEORGE E. SYMONS, Ph.D.

Dr. Symons is Consultant and Technical Editor, Larchmont, N. Y. In this series he discusses *Water Works Practices* in the form of short course lectures. These are designed to assist plant operators, students, and all who wish to review fundamentals in this field.

C . . . Rapid Sand Filters

1 . . . DESIGN

a. Rapid sand filters differ from slow sand filters in four respects.

(1) Size—usually 1/100 to 1/10 of an acre in area.

(2) Rate of flow—15 to 100 times as great.

(3) Need for pretreatment of water.

(4) Method of washing by reversing the flow of water through the filter.

b. Early filters were patented and constructed and sold as units by manufacturing companies; Continental, Jewell, and Hyatt were famous names early in the 20th century. Many of the early filters had mechanical devices for raking or stirring the surface of the sand during washing; therefore, rapid sand filters were frequently termed "mechanical" filters.

c. Modern rapid sand filters generally are concrete boxes rectangular in shape, 10 to 12 ft deep. The essential parts of the filter are:

(1) Underdrain system to outlet and wash water line.

(2) Graded gravel and sand layers.

(3) Wash troughs to carry away wash water.

(4) Inlet system.

(5) Appurtenances, including valves, rate controllers, instrumentation, and surface washing devices, etc.

d. The size of the rapid sand filters depends on the desired capacity of the filter plant and the number of filter units feasible.

(1) Filter plants are seldom constructed with less than two filters, generally a minimum of four for plants with a capacity of 2 mgd or more.

(2) The maximum capacity of rapid sand filters is usually 6 mgd per unit.

e. Other shapes of filters are used, as are other types of construction.

(1) Wood and steel are used, especially where low cost of construction is desired.

(2) An important type of filter developed in the early 1950's is the Dorr-Aldrich "Peri Filter," constructed of steel as a concentric ring around the outside of a circular coagulation and sedimentation basin.

2 . . . UNDERDRAINS

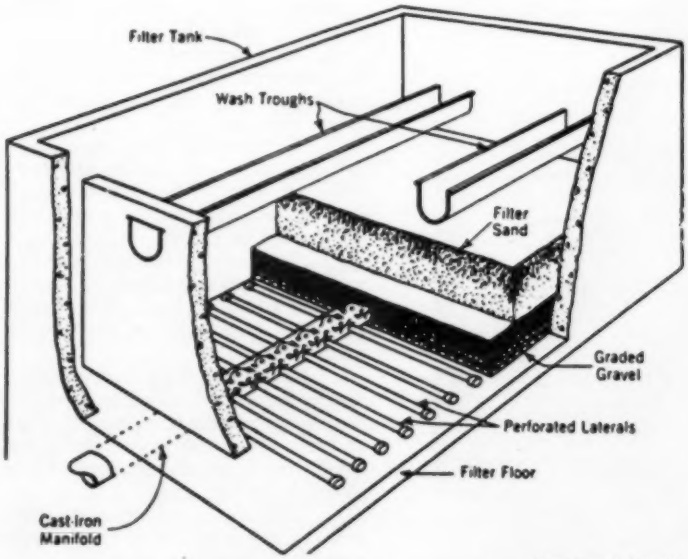
a. Underdrains in a rapid sand filter serve two, and in some designs three purposes.

(1) An outlet for water passing through the filter.

(2) A means of supplying wash water to the underside of the filter.

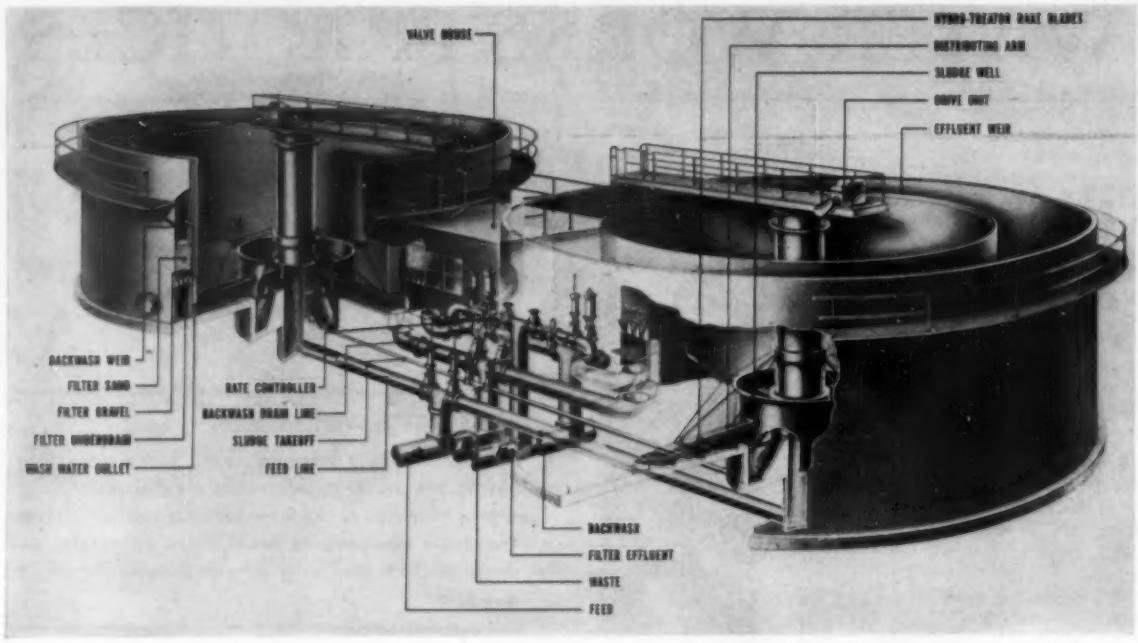
(3) Where the underdrain is a false bottom design, it serves as a

* Part 1 of this lecture on Filtration, covering "Fundamentals" and "Slow Sand Filters," appeared on pages 108-111 of the March 1956 issue of W&SW.



(Courtesy of AWWA)

CUTAWAY view of typical rapid sand filter



PHANTOM VIEW of Dorrco-Aldrich Peri Filter system

support for the layers of gravel and sand in the filter.

b. Design of the underdrain system is governed mainly by the need for delivering the wash water evenly over the entire bottom of the filter, because the rate of flow of wash water is many times the filtering rate.

(1) One principle of design keeps the head loss through the orifice high in relation to the friction losses in the manifold and laterals of the underdrain system (perforated pipe).

(2) A second design principle applies the wash water to the underside of the filter at practically no velocity by means of a double bottom in the filter (false bottom).

c. Perforated pipe grids are still most common, many of them predating the advent of the false bottom system.

(1) This system consists of a central main or manifold running the length of the filter with laterals spaced at intervals and extending to the side walls.

(2) Laterals may be cast-iron, wrought iron, or asbestos-cement pipe. They are perforated.

(3) Perforations are from ¼ to ½ in., spaced at 3-in. intervals for the smaller size and up to 8 in. for the larger openings.

(4) Perforations must be at least 0.3 sq in. per sq ft of filter and generally are directed downward toward the floor with the laterals completely surrounded by gravel.

(5) The perforations may face upward and contain strainers of several designs, usually of brass or bronze in an umbrella or cylinder shape with small perforations.

... Velocity of wash water leaving the perforations is killed by directing the jets toward the bottom of the filter and into the coarse gravel, or by the small jets from the strainers being directed into the gravel.

... Head loss in this type of underdrain ranges from 3 to 15 ft and averages about 9 ft for a wash water rise of 30 in. In some waters there is a

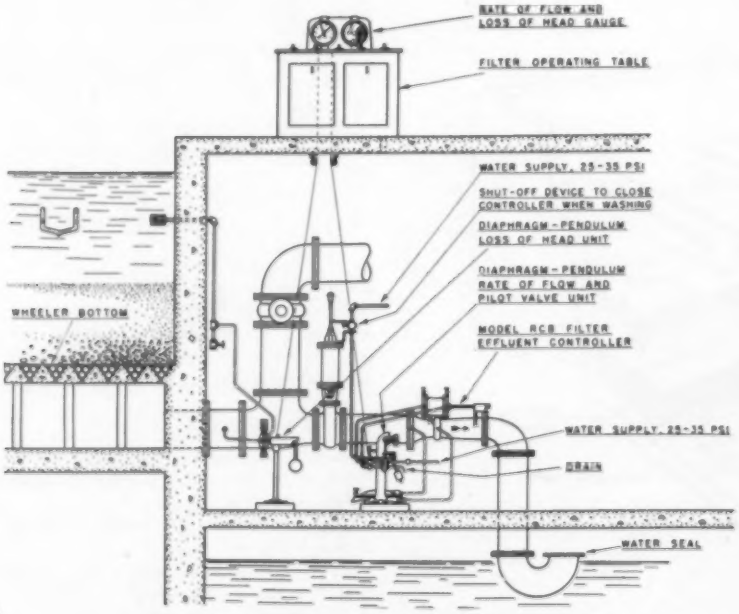

RATE OF FLOW AND LOSS OF HEAD GAUGE
FILTER OPERATING TABLE
WATER SUPPLY, 25-35 PSI
SHUT-OFF DEVICE TO CLOSE CONTROLLER WHEN WASHING
DIAPHRAGM-PENDULUM LOSS OF HEAD UNIT
DIAPHRAGM-PENDULUM RATE OF FLOW AND PILOT VALVE UNIT
WHEELER BOTTOM
MODEL RCB FILTER EFFLUENT CONTROLLER
WATER SUPPLY, 25-35 PSI
DRAIN
WATER SEAL

DIAGRAM of filter and pipe gallery arrangement

(Wheeler Bottom) **UNDERDRAINS of false bottom type** (Leopold Bottom) (Porous Plate)

tendency for perforated strainers to clog and increase the head loss.

d. False filter bottom systems have grown in popularity with engineers since the first design by Wm. Wheeler was installed at Belfast, Me., in 1913.

(1) The Wheeler filter bottom consists of a false concrete bottom supported by piers about 22 in. above the floor of the filter.

... Uniformly spaced, inverted pyramidal depressions contain specially proportioned, porcelain spheres and have a cast-in porcelain orifice at the bottom through which the water flows. Conventional layers of gravel and sand are placed on top of the porcelain spheres.

... Head loss is from 1.9 to 3.5 ft for a wash water rise of 30 in. per min, depending on the type of construction, whether precast or monolithic.

(2) The Leopold bottom consists of hollow glazed fire-clay blocks, which replace the manifold and laterals.

... Both filtered and wash water pass through perforations in the top of the blocks.

... The hollow blocks serve as laterals.

... Only fine gravel is used on top of the block to support the sand.

... Head loss during back wash is approximately 2.5 ft for a wash water rise of 30 in. per min.

(3) The porous plate underdrain is sometimes termed the Camp bottom, when supported by studs to form a false bottom above the filter box floor. It also may be supported by concrete piers.

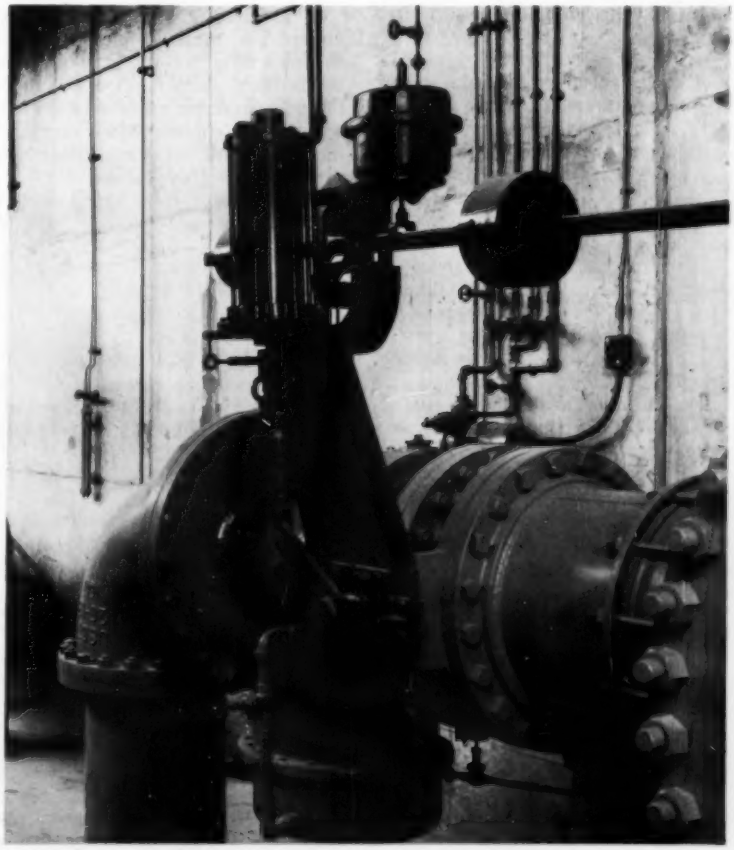
... The porous plate is made of fused aluminum oxide, in which the porosity is controlled during firing of the plate.

... No gravel is required; sand is placed directly on the porous plate.

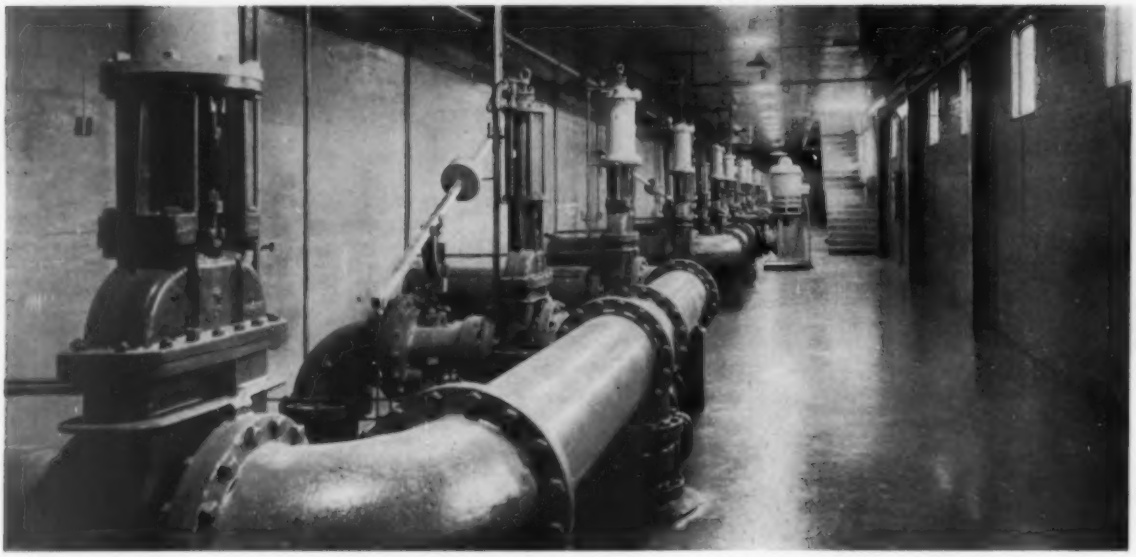
... Head loss through the plates is similar to that in other false bottom filters. In some waters and under conditions of improper filter operation there is a tendency for precipitation of minerals and organic growths to clog the plates. Cleaning is done with inhibited muriatic acid, sodium hydroxide, or by removal and reburning the plates, depending on the cause and condition of clogging.

3 ... Wash Water Troughs

a. In back-washing a filter, it is desired to maintain a uniform upflow over the whole filter bed. This means that static head on the filter must be equal over the whole area.



RATE controller by Simplex Valve & Meter Co.



FILTER pipe gallery

(1) Uniform static head is assured only if the water does not have to travel far over the surface to reach the outlet.

(2) Wash water troughs or gutters are used to accomplish this desired condition.

b. Wash water troughs may be constructed of concrete, metal, wood, or asbestos-cement pipe.

(1) The most common shape in older filters is a V-bottom with vertical side walls, but this shape results in uneconomical construction and rectangular or semi-circular cross-sections are now favored.

(2) Troughs are usually spaced so that the travel of water across the surface is from 2.5 to 3.5 ft; that is, the troughs are placed 5 to 7 ft apart.

... In large filters, the wash water trough system may have two longitudinal troughs with laterals extending in both directions to give a tree system arrangement.

(3) The capacity and height of the troughs above the bottom of the filter and above the sand are dependent on the designed rate of wash water to be used; that is, the inches rise per minute.

... The higher the rate of wash water rise, the greater the volume of water to be carried away and the greater the expansion of the sand bed; therefore, the larger the troughs and the higher above the sand surface. Usually, the height above the surface of the bed will allow for 50 per cent expansion of the sand bed without the sand reaching the bottom of the trough.

... Older filters were designed for wash water rise rates of 24 in. per min. Modern practice uses rates of 30 in. and up to 48 in. per min.

4 ... FILTER MEDIA

a. In all filters using perforated underdrain systems and with the Wheeler filter bottom, graded gravel, 12 to 15 in. deep is used to support the filter medium (sand or anthracite coal). The Leopold bottom uses a few inches of small size gravel; the porous plate uses no gravel at all.

b. The filter medium is usually clean quartz sand from 24 to 30 inches deep.

c. Sand for filters is selected with two factors in mind:

(1) Downward passage of the water during filtration.

... The size should be such that it will prevent the passage of floc through the filter, hold floc loosely to permit easy washing, and hold a large volume of floc.

(2) Upward passage of the wash water.

... The size should be such that it will tend to float in the rising wash water, cleanse itself from adhering floc, and permit passage of water at a sufficient velocity to remove "dirt" but not the sand.

d. According to Prof. E. W. Steel, the choice between coarse and fine sands rests on these considerations.

(1) Coarse sands may be suitable (a) if pretreatment is good, (b) if the water is not highly polluted, (c) if longer filter runs and less wash water used outweigh poorer quality water, and (d) if the filter design permits high back wash rates.

(2) Fine sands may be suitable (a) if pretreatment effectiveness varies, (b) if high removals of bacteria and turbidity are required, (c) if the economic savings of long filter runs and low wash water use are not important, (d) if filter design permits low backwash rates that will clean only the fine sands, and (e) if water softening is practiced and sand grain incrustation and growth are expected.

e. There are two methods of specifying filter sand.

(1) The most common calls for an effective size of 0.45 to 0.55 mm, with a uniformity coefficient of 1.70 (max) to 1.20 (min).

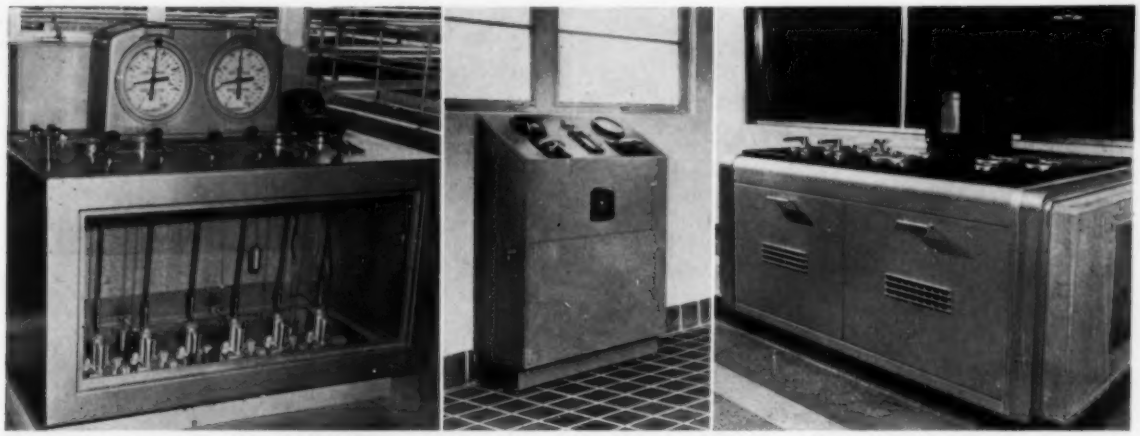
(2) The Riddick system of specification (see *Wat. & Sew. Wks.*, Ref. & Data Ed., p. R-76, May 1950) uses a "per cent retained on sieve sizes."

... These specifications call for (a) the finest sand to be used in that retained on a 48-mesh sieve (Tyler sieve series), (b) the predominant sizes should be 35 and 28 mesh, (c) the 48- and 20-mesh sizes should be limited to not more than 10 per cent each with the 20-mesh omitted if possible.

... Thirty-five mesh sand has an average size of 0.5 mm, and is necessary to remove activated carbon, if used.

f. Crushed anthracite coal, known as "Anthrafilt," is used in place of sand in many places.

(1) "Anthrafilt" has a specific gravity of 1.5 compared to approximately 2.65 for sand; therefore, it has greater bulk (1.4 cu yd per ton) than sand (0.75 cu yd per ton). Although



FILTER tables: Left—Builders-Providence six-valve table for two filters with panels removed to show valve operating system; center—Foxboro filter table at Fairfield, Calif.; right—Simplex Valve & Meter Co. table at Allentown, Pa.

more costly per ton than sand, its lower transportation cost per cu yd makes it economically competitive in some locations.

(2) Crushed anthracite is coarser than sand, having an effective size of 0.65 to 0.75 mm and a uniformity coefficient of 1.6 to 1.75. Depth of the bed is about the same as for sand.

... All observers report that the lower specific gravity requires only approximately 50 per cent of the wash water rise per min to obtain the same bed expansion as for sand.

... Anthracite coal of the same effective size as sand has a greater porosity and therefore lower head loss and longer filter runs.

... Ullrich, at Austin, Tex., reported that in lime softened water deposition of calcium carbonate on the anthracite increased its specific gravity and therefore nullified, to some extent, the lower wash water rise requirement; but he added that the encrusted grains continued to do a good job of filtering and that "Anthrafilt seems to have an advantage where lime softened water or water easily coagulated and settled is to be filtered."

... Mounsey, at Lawrence, Kan., reported a comparative study of Anthrafilt and sand filters on a lime softened water and concluded that with 16 inches of wash water rise for Anthrafilt (23 in. for sand), the anthracite media showed these advantages: (a) no appreciable loss of media, (b) longer filter runs even with poorly coagulated water, (c) cleaner media with the same volume of wash water, (d) coating with calcium carbonate less rapid than on sand, (e) no apparent difference in quality of effluent.

... Anthracite particles are said to remove iron and manganese better than sand.

... One industrial water supply, using an alkaline water, reported that unlike sand, there was no tendency of anthracite to dissolve.

5 ... APPURTENANCES

a. In addition to the underdrain system, wash water troughs, and filter media, several appurtenances are required for operation of a rapid filter.

CONSOLE-type filter table by Builders-Providence

b. Valves are necessary for each filter on the influent, effluent, wash water supply, wash water waste, rewash line and air wash line where used.

... Valves are located below the operating deck between the rows of filters, in a pipe gallery where the various pipes to and from the individual filters connect to header lines.

... Valves may be tight-closing butterfly valves or gate valves and may be operated manually, hydraulically or electrically.

c. A rate controller is used on the filter effluent line to maintain the filtering rate at the designed value (see section on "Rate of Flow"). Another rate controller is used on the wash water line to assure that the wash water rise is constant and at the desired rate.

d. Where valves are electrically or hydraulically operated, the operating control devices are housed in and on a "filter table," or filter console panel.

e. Instruments showing the loss of head, rate of flow, valve positions, sand expansion, total flow, rate of wash water rise, etc., may be housed in the filter table or in a separate panel board, located on the "filter operating deck," also termed "filter gallery."

... Summators and large-scale dials may be used in the filter room to show flow rate and total output of the several filters.

... Duplicate instruments may be installed in the filter plant superintendent's office or operating control room.

f. Automatic or semi-automatic control systems and instruments for control of operating and washing

FILTER operating galleries at Cleveland, Ohio, and Allentown, Pa.

cycles are placed in panels, usually in the operating control center (see section on "Filter Washing").

g. A sand expansion indicator may be used to indicate the location of the surface of the filter sand during washing.

(1) One type uses a properly protected light on a calibrated rod which is submerged until the light is extinguished by the sand.

(2) Another type is a hollow counterweighted cone connected by cable to the indicator dial. As the bed expands the cone moves upward with the surface of the sand.

h. Surface wash devices have grown in popularity since 1936.

(1) These devices provide a high-pressure jet of water (20 to 50 ft of head) at the surface of the sand to aid in the scrubbing of the dirtiest section of the filter.

(2) Two designs are favored.

... The stationary grid of pipes with orifices directed downward as designed originally by Baylis at Chicago.

... The Palmer "Filter Sweep," consisting of two rotating arms on a fixed swivel supported from the wash troughs. These arms are located just above the surface of the unexpanded sand bed and rotate due to the reaction of water discharged under pressure from the several jets in the arms, like a reaction-type lawn sprinkler.

i. Conduits leading to and from a filter are generally designed for differing velocities of flow, depending on the line and its use.

(1) Influent lines, 1 to 2 fps.

(2) Effluent lines, 3 to 6 fps.

(3) Wash water inlet lines, 8 to 12 fps.

(4) Wash water outlet lines, 5 to 8 fps.

(5) Rewash lines, 10 to 15 fps.

j. A clear well to receive and store filtered water is a part of the filter plant. Its capacity should be sufficient for several hours of operation. High-service pumps take suction from the clear well.

6 ... Rate of Flow

a. The rate at which water is passed through the filter has always been considered to be important.

(1) Rate of filtration depends on size of filter; size, grading and depth of filter medium; efficiency of preliminary treatment; and quality of water desired.

(2) Generally, it is considered that the rate of filtration should be constant, because sudden increase in rate may cause incompletely filtered water to break through, or sudden increase in negative head may release dissolved gases, or a sudden decrease in rate may allow an air bubble entrained in the sand to escape and make a hole in the filter bed.

(3) Studies at Harvard University in 1953 indicated that a varying filter rate might be advisable, with the rate above the average as the filter begins operation and decreasing as the head loss increases until the minimum rate allowable is reached at the end of the filter run.

b. Recommended Rates

(1) Standard practice for many years has been to operate filters at a designed rate of 2 gpm per sq ft.

(2) Studies by Baylis at Chicago, and others elsewhere, have indicated that filters can be successfully operated at rates of 3 to 5 gpm per sq ft. Baylis (*Wat. & Sew. Wks.:* 97, 456: 1950) indicated that:

... At 5 gpm per sq ft, the initial loss of head through the filter bed (at 74° F) is 0.9 ft, whereas at 2 gpm it is 0.4 ft; at 32° F the initial loss is 1.8 and 0.7 ft, respectively.

... Length of filter runs at 5.0 gpm per sq ft is half as long as at the 2.0-gpm rate.

... Quality of filter effluent, both as to turbidity and bacteria, is satisfactory at the high rate.

... Filter performance, as measured by gallons of water filtered per foot increase in loss of head, is greater for high-rate filtration, indicating a saving in wash water.

(3) Baylis (loc. cit.), Cox (*Wat. & Sew. Wks.:* 100, 400: 1953), and Jackson (*JAWWA:* 47, 129: 1955), all indicate that pretreatment must be of high efficiency and consistently good in order that high-rate filtration will be successful and satisfactory.

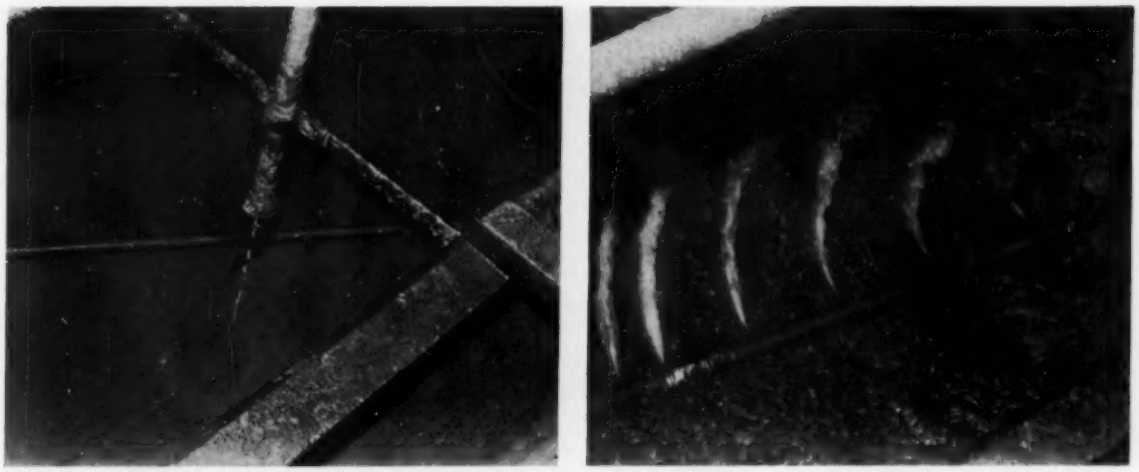
... Attempts to convert standard-rate filters to high-rate operation may fail if the pretreatment processes are not adequate.

(4) State health departments have shown a hesitancy to approve the higher rates of filtration, but the AWWA "Manual of Water Quality and Treatment," 2nd Ed., pointed out that "the present trend in filter design is to prepare the water more adequately and to filter at a much higher rate" than 2 gpm per sq ft.

c. Methods used for controlling rate may be manual or automatic, although manual control is almost a thing of the past.

(1) Manual control may be accomplished in two ways.

... Apply water to the filter at a



SURFACE WASH units—Palmer "Filter Sweeps" before and after start of operation

constant rate by control of the influent valve and by manually adjusting the effluent valve from a slightly open to a full open position as the head loss increases during the filter run. [Note: a recent variation (1950) of this type of control, to place it in the automatic category, is to use a butterfly valve on the effluent line, operated by a float in the water on the filter. Pumping or discharge of water onto the filter must be at the constant rate desired.]

... Maintain a constant depth of water on the filter by a float-operated influent valve and adjust the effluent valve at intervals to maintain the rate desired as indicated by a measuring device on the effluent line.

(2) Automatic rate control of filter operation may be accomplished by two types of devices, one open, one submerged. (A history of filter rate control, by Chas. G. Richardson, was published in *Water & Sewage Works* in April 1953.)

... The open type, seldom used in modern practice, depends on a float attached to a weir in an open cylinder. This design was one of the earliest used.

... The submerged type, by far the most common, depends on a Venturi tube, which measures the flow of water through the effluent line and converts any deviation from the set rate into a power-actuated mechanical operation which accordingly opens or closes a valve in the device.

The most recent design of this type of controller contains a tight closing butterfly valve on the effluent side as the control vane, thereby eliminating the need for any other valve on the filter effluent line.

... As indicated in the lecture on "Instrumentation and Control," complete filter plant control can be effected from the level of water in the clear well.

... Back washing control is discussed later under the section on "Operation—Filter Washing."

(Ed. Note: Because of the length of this lecture on Filtration it will have to be concluded in the next issue, at which time the reference works will be listed.)

Friel Honored by Professional Engineers

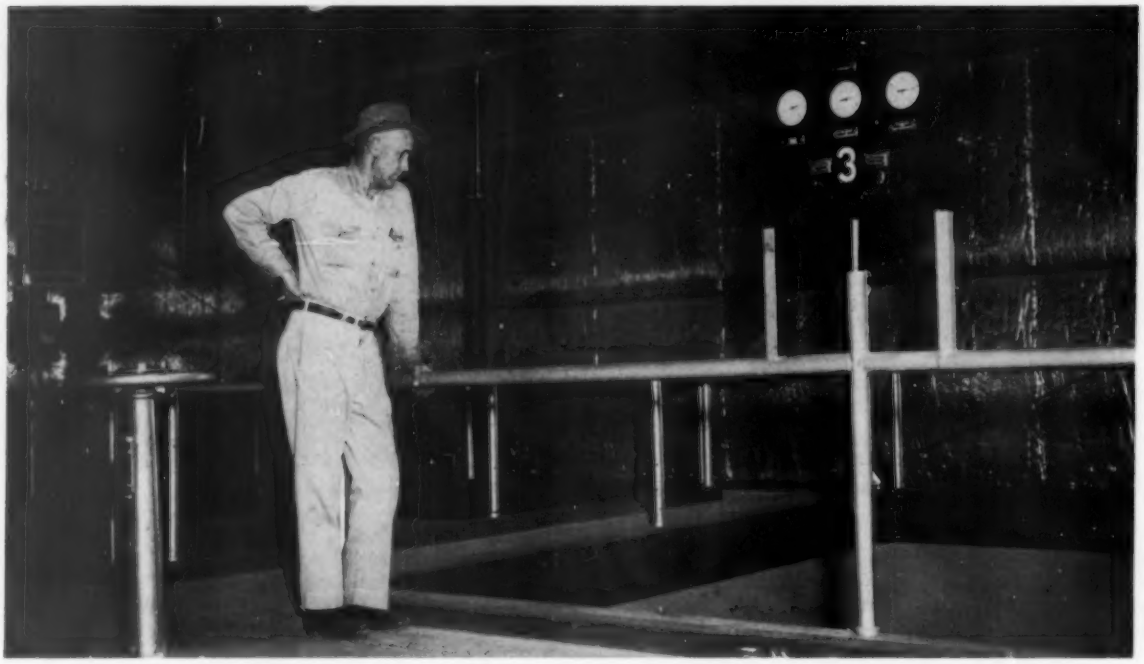
Francis S. Friel, president of Albright and Friel, Inc., consulting engineers of Philadelphia, has been honored by the Pennsylvania Society of Professional Engineers, which cited him as "Metropolitan Philadelphia's outstanding engineer."

Presentation of the award was made February 21, 1956, by Allan H. Kidder, (left in the picture) a director of the National Society of Professional Engineers, at a luncheon at the Philadelphia Engineers' Club, highlighting the celebration of National Engineers' Week. Dr. James Creese, president of Drexel Institute of Technology, of which Mr. Friel is an alumnus, is at the right.

Mr. Friel was cited for his "untiring efforts and service to society and to the engineering profession through his exemplary recognition, acceptance, and discharge of personal responsibility for advancing public welfare through civic, educational, and national works."

A 1916 graduate of Drexel Institute of Technology, Mr. Friel was awarded an honorary degree of Doctor of Engineering by that Institution in 1949, and now serves as a member of its Board of Trustees. He is a member of the honorary fraternities Tau Beta Pi and Chi Epsilon and is currently president of the American Institute of Consulting Engineers.

Of all the great industrial nations, the one that has clung most tenaciously to a system of private enterprise (capitalism) is the one that today has come the closest to the socialistic dream of producing an abundance for all.



INSTRUMENT PANEL as mounted on the filter guard rails, Farmington, N. M.

Uranium Boom-Town Gets a Water Plant

How a much-needed filtration plant was supplied in a hurry

by JOHN SEAGRAVES

Mr. Seagraves, former sanitary engineer with the Pennsylvania State Health Department, is Industry Engineer with Minneapolis-Honeywell Regulator Co., Philadelphia, Pa. He tells of a rush installation of a fully automatic filtration and pumping plant desperately needed by uranium boom-town, Farmington, N. M.

WITH THE RECENT discoveries of gas, oil, coal, helium and uranium beneath its rich soil, Farmington, New Mexico, needed a water filtration plant in a hurry. The town's 1950 population of 3,637 quadrupled in four years; consequently, its dug wells could not supply enough water.

Fortunately, Farmington is located at the fork of the San Juan and Animas rivers where the lowest daily record of flow on the Animas river is 40 second-feet. However, the construction of a rapid sand filtration plant for river water presented several unusual complications. First of all, funds were limited. Secondly, manpower was scarce, and the plant would have to operate automatically most of the time. Thirdly, the town's power supply was also inadequate and failed frequently so that any control system had to be designed for automatic starting and stopping in case of temporary power failure. Finally, it takes some time to design and construct conventional water plants, but as in all boom towns, safe water was needed immediately.

Filter Plant Design

To solve its problems, Farmington built a sheet steel and concrete filtration plant having a capacity of 4 mgd at a cost of only $125,850. Moreover, the plant was automatically pumping water within three months from the day that the contracts were signed. W. C. Powell of Sante Fe, N. Mex., designed the plant and Minneapolis-Honeywell engineers developed the controls to meet Farmington's special

requirements due to local conditions.

River water flows by gravity to a coagulation and sedimentation basin, then through four parallel operated filters to a clear well. From here, it is pumped to the storage reservoir. Flow throughout the plant is controlled by butterfly valves of what is known as the wafer type.

Flow to the sedimentation basin is controlled by a float-actuated switch which starts and stops an electric motor operator for the 12-inch valve on the line from the river.

The flow from each filter can be controlled either automatically or manually. There are no filter operating tables such as one sees in most plants. Instead there is a small instrument panel mounted on the guard rail in front of each filter. On each panel, there are three indicating pneumatic receiver dials, an automatic-manual selector switch and a manual pressure regulating valve. When the switch is on automatic, the regulator establishes the set-point pressure for an automatic rate of flow controller; when the switch is on manual, the pressure regulator positions the valve controlling the rate of flow to the filter.

DIFFERENTIAL CONVERTER for measuring and controlling filtration rates

Pneumatic Transmitters for Flow and Loss of Head

Flow from the filters is measured by a differential converter mercuryless manometer and an orifice plate. This manometer transmits both to the flow indicator and to the rate of flow controller a pneumatic pressure signal that is proportional to the rate of flow. The controller in turn compares the signal from the manometer with that from the pressure regulator and, if they differ, changes the air pressure on the diaphragm motor operator of the valve.

In effect then, the controller repositions the valve so that the rate of flow from the filter will be that which was selected by the operator when he set the pressure regulator. On the panel, one dial indicates flow rates, the second indicates set-point air pressure if the filter is on automatic control or valve pressure if the filter is on manual control, and the third dial indicates loss of head through the filter.

Loss of head is also measured by a Differential Converter unit tapped into the upstream and downstream sides of the filter bed instead of across an orifice.

In Case of Air Failure

Upon air failure, all of the valves close and the plant will shut down automatically if power failure stops the air compressor. In addition, other controls bleed air from the valves whenever it is necessary to close them in order to maintain high or low level limits. For example, they bleed air from the valve in the line to the filters when filter or reservoir level is too high. Others throttle the rate of flow valves in the filter effluent lines should the filter levels drop too low.

A float-operated electric switch at the reservoir starts and stops the pump between the clear well and the reservoir. In addition, controls on the clear well stop the pump and close a valve at low clear well levels.

Filter backwashing is manually controlled with the aid of a Brown wash water rate of flow indicator. Otherwise the plant requires but little manual supervision, and has been producing water satisfactorily for more than a year now. The plant was undoubtedly well designed to meet the unusual requirements of a boom town. Farmington had safe water when it needed it. Now, with the town still growing rapidly, additional facilities are being designed.

W&SW

Popless Pop Eases Water Shortage

When raging floods ravaged many New England communities a few months ago, a large soft-drink bottling plant in Waterbury, Conn., helped relieve that city's drinking water shortage.

Because of the flood, much of the city's water was considered undrinkable. But the Coca-Cola bottling company filters all the water that goes into its beverage. Instead of turning out cases of soft drinks, it offered plain soft water, instead.

Between 6,000 and 8,000 persons received water free from the company which continued the service throughout the emergency.

Byzantine Sewer System Unearthed at Haifa

Discoveries of ancient relics made in Haifa recently reveal a striking parallel between ancient and modern city structure. Digging of a new central sewer has brought a Byzantine sewer system to light. The new sewer will serve a new treatment plant.

The Byzantine sewer, which was uncovered near the Old Railway Station in lower Haifa, is rectangular in shape and is made of stone slabs. Thirty graves and two heaps of rubbish enclosed in stone were found near the sewage pipe. The graves have been dated from the Byzantine period; the dumps are thought to be relics of the eighth to twelfth centuries, A. D.

New Rate Controller for Water Filter Plants

A FILTER CONTROLLER faces a unique requirement. Although basically a head-loss producing device, it must, at the wide open position, produce the least possible loss. If the loss through the controller wide open is high, the filter run will be correspondingly shortened. Nevertheless, the throttling element should continue to produce loss right up to the wide open position; otherwise, the unit drifts and loses control in the last part of the run. The logic behind the design of a unit previously described elsewhere*, confirmed by more than twenty years of experience with it, indicates that the accomplishment of the foregoing objectives depends on *throttling at a high-velocity section* just downstream of the Venturi throat. When the throttling is done at such a section, even the slightest interference with the flow produces a substantial loss, thus insuring control right up to the wide open position. However, it also requires that the throttling member be removed completely from the flow section at the open position or that it become a part of the smooth boundary of the flow section.

by E. FRANK STOVER

Mr. Stover is Director, School of Civil Engineering, University of Pennsylvania, Philadelphia, Pa. His article describes a new pneumatically operated rate controller of simplified compact design, which is claimed to have all the virtues of an earlier unit*, plus several additional ones.

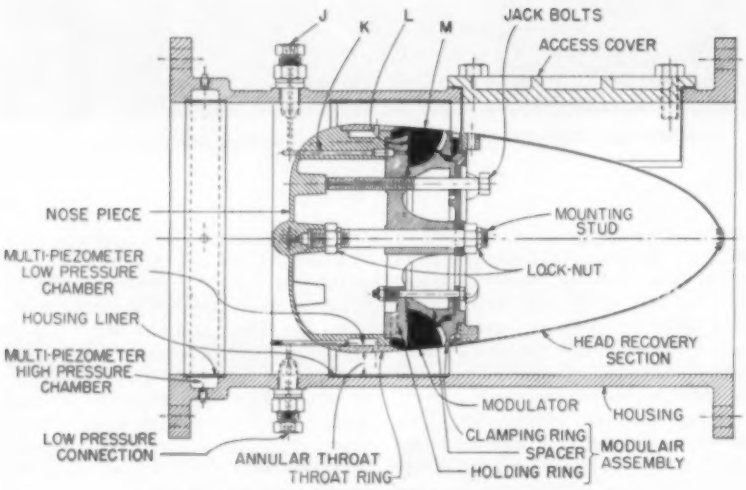


Fig. 1a—Detail of section through the new rate controller

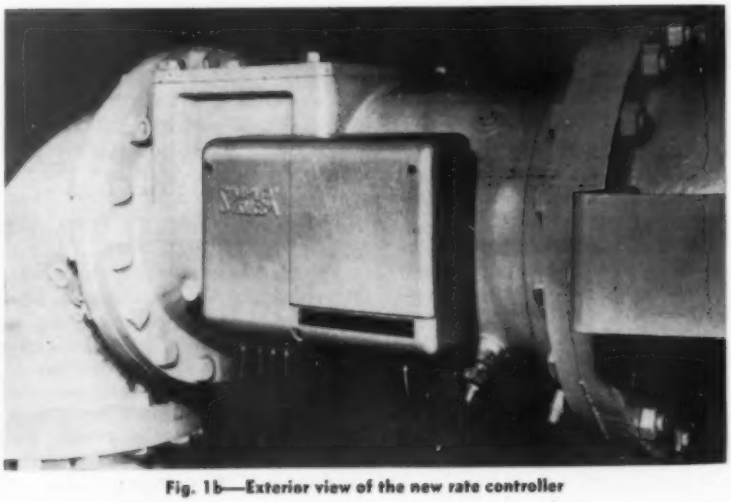


Fig. 1b—Exterior view of the new rate controller

Every filter plant operator is looking for hydraulic equipment of high dependability. Even super precision and sensitivity are dearly bought if frequent breakdown, adjustments and repairs must be accepted with them. The attainment of dependability implies that in the design of equipment the cumulative deleterious effects of all properties of the water handled must be considered in the selection of materials and in the proportioning of the mechanical elements. The effects of wear and the disabling influences of air inducted during parts of the operating cycle should be designed out.

The New Controller

The controller shown in section in Fig. 1a and in exterior appearance in Fig. 1b, is the result of seven years of study and testing with the previously stated objectives in mind. The

* See *Water Works & Sewerage*, September, 1934.

controller consists of a cast-iron pipe section slightly over two diameters in length which has an access opening near the downstream end of the section. The bore is bronze-lined from the upstream end to the access opening. An egg-shaped body (Fig. 1a) is supported in the bore, in axial alignment, by four radial arms of streamlined section. The pipe section with its egg-shaped interior body forms an annular throat Venturi. This is the metering element of the controller. The radial arms of the inner body, with the fittings which anchor it to the pipe wall, provide connections for the Venturi pressure and for operating air lines. At its section of largest diameter the egg-shaped body carries the throat pressure belt. Since the piezometer openings are on the body's exterior surface, they automatically vent any air which may enter when the effluent line is empty.

Just downstream of the throat belt is the throttling element, or modulator, which is *the unique feature* of this controller. It is shown at M in Fig. 1a and in enlarged section in Fig. 2. It is a single moulded piece of high-quality vulcanized rubber with the ruggedness of a truck tire. It is responsive to operating air through connection J and passageway K applied against the face, L, of the throttling element.

Various devices of the control valve type have been designed and patented using rubber as a valve element. Many of them are unworkable because the easy deformability of the rubber causes flutter, bad control, and early failure of the element. In this case, the proper use of rayon truck tire reinforcing allows circumferential deformation to accomplish throttling action, but at the same time provides practical rigidity in the direction of flow.

Functioning of This Throttling Element

Fig. 2 shows the rubber element in its collapsed position and (dotted lines) in its expanded position. In the collapsed position its outer surface forms part of the profile of the egg-shaped body where it offers no resistance to flow. When fully expanded by the applied air pressure, it makes complete contact with the pipe wall and provides tight closure against the filter head. Throughout its motion the throttling member hinges elastically about its upstream mounting bead, which carries all the load due to water and air pressures. On the downstream side a thin, partly reversed reinforced rubber sleeve, whose downstream end is clamped to the mounting casting, provides air tightness with freedom of motion. With this unique construction there are no moving metal parts within the pipe, and no motion to be transmitted through the pipe wall by mechanical means; hence, no stuffing boxes. The great simplicity of this design may be emphasized by listing the parts for an ordinary diaphragm-type regulating valve, the functions of which are all performed by this single moulded rubber element. They are: a valve; a valve seat; a valve rod; a spring; a complete stuffing box assembly; two diaphragm plates; a diaphragm; and two halves of a diaphragm casing.

Rubber, when continually wet and protected from light, as it is in the interior of a flow controller, is an extremely enduring material. One test controller has been in field service for three and one-half years. Inspection of the rubber element shows no wear or loss of elasticity. A laboratory endurance test was run on a rubber element mounted on standard mounting plates and immersed in water. It was fully expanded and collapsed by air pressure fed through a cycling control for a number of cycles corresponding to thirty years of service at one filter wash per day. No wear or deterioration of any kind resulted. Trouble is often caused in control devices by the incrustation of metal parts by rust, silt or chemicals to such a degree that clearances are destroyed or surfaces are excessively roughened. This rubber element, because of its resistance to chemical action, and because it is distorted continually during operation, remains perfectly clean even after long use.

Pneumatic Features of Two Types

In any pneumatic device which operates around the clock year after

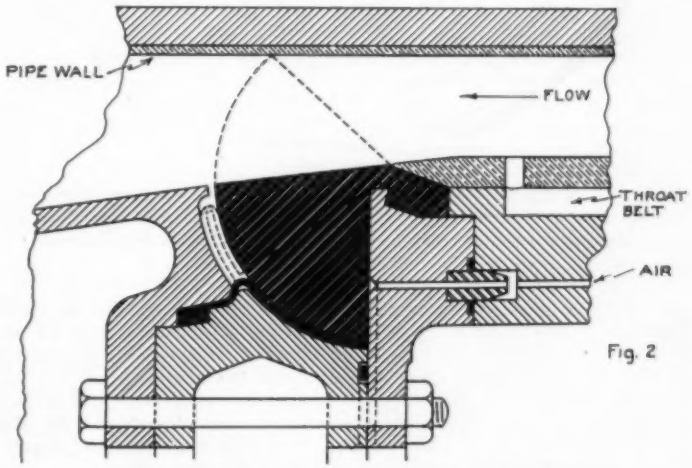


Fig. 2—The throttling element of the new rate controller

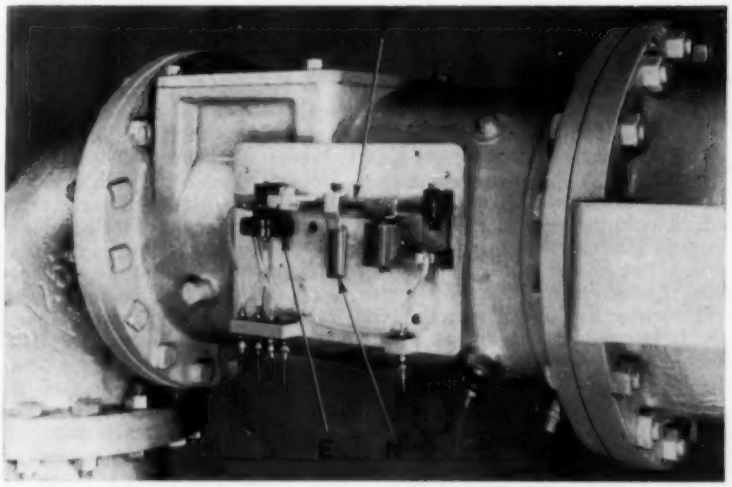


Fig. 3—Controller with bonnet removed from balanced-lever air control unit

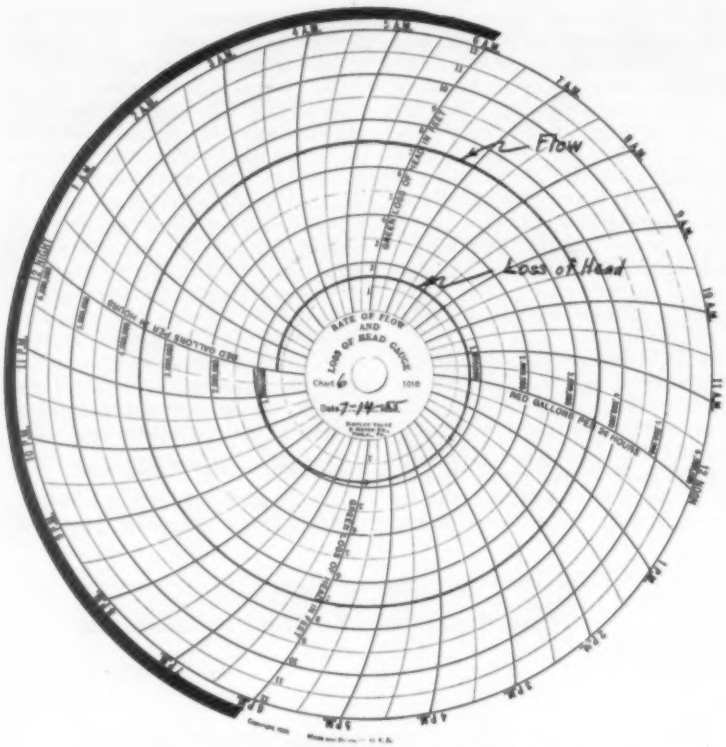


Fig. 4—Typical 24-hour flow rate and head loss chart
(Arrows point to flow rate pen line, which lies on the 3.5-mgd circle; and loss of head pen line, starting at 1.2 ft and rising to 2.2 ft in 24-hr period)

year, air consumption is a matter of importance. The quantity of air used is usually determined by the design of the air feed mechanism, rather than by the type of diaphragm receiving the pressure. However, large clearance volumes in the latter can influence the speed of response and to a slight extent the quantity of air used. Fig. 2 shows that no dead clearance volume remains behind the rubber element when the flow passage is wide open. Thus, when air is applied to close the flow passage it acts at full pressure from the first instant.

Two types of balanced-lever air feeds have been developed for this controller. One, intended for use with larger units and having greater air handling capacity, is of the null type which locks the air behind the rubber throttling element so long as the effluent rate is correct. The rate is sensed at any convenient time interval, such as five or ten seconds, and air is injected or bled off as necessary. Once control is attained this feed uses about 0.05 cfm of free air.

The second type, which has been used successfully on controllers up to 16-in. pipe size, is of simpler design and uses about 0.15 to 0.20 cfm of free air. As shown in Fig. 3, it consists of an elastically-mounted scale beam, F, the short arm of which is loaded with the diaphragm load, E, from the Venturi head. The long arm carries a small poise, N, which can be set for any desired rate up to the capacity of the filter. Any departure of the filter rate from its set value acts through the diaphragm on the short arm to increase or decrease the air pressure on the rubber throttling element in the controller. A diaphragm movement of 0.001 in. will swing the applied pressure from full value positive to about 3 psi negative. This small diaphragm movement draws only about 0.003 cu in. of water through the Venturi leads and insures instant response to any change in rate. In case remote setting air control is used, the long arm of the beam is subjected to a diaphragm load due to air pressure regulated at a central point. Fig. 3 shows a combination of a manually set poise with an air diaphragm in reversed position for control from clear well level.

Fig. 1b shows the air feed panel mounted on the side of the body casting. However, it can be mounted on a nearby wall, a floor pedestal, or a pipe flange bracket at any reasonable distance from the controller body. Such flexibility allows the controller body to be installed in any position, horizontally, vertically, or at any angle, without any alteration whatever. The advantage gained in simplification of pipe layout by vertical installation has been amply demonstrated in several plants, such as that at Milwaukee, Wis., and elsewhere. It also may be seen from Figs. 1b and 3 that this controller will fit wherever a piece of pipe will fit. There are no clearance problems.

The unit shown in Fig. 1b was manufactured under license by the Simplex Valve and Meter Company, Lancaster, Pa., and is installed in the plant of the Chester Municipal Authority at Oxford, Pa., in the 16-in. effluent line of a 5.4-mgd filter. Recording filter rate and head-loss gauges keep a daily record of its performance. Fig. 4 shows a chart from one day of operation at about 3.5 mgd with filter loss increasing. This chart speaks for itself as to accuracy of control and smoothness of operation. Charts accumulated over months of operation show the same quality of control for a wide range of rates and for head losses over the full range encountered in gravity filters.

Features of the Annular Throat Design

The annular throat Venturi has a smaller angle of divergence in the recovery section than would be found in a conventional Venturi of equal ratio and length. This reduces turbulence and results in an overall loss, with the controller wide open, no greater than would be found in a standard Venturi used for metering only. The benefits of this low loss in the wide open position are realized in longer filter runs, since practically all the available head is usable for overcoming filter resistance rather than high residual controller resistance. Longer runs and decreased consumption of wash water can influence the economy of plant operation considerably.

The annular throat Venturi has the added advantage of forming no pockets for the trapping of either air or silt. Judged from the results of three and one-half years of field and laboratory tests this controller offers to the water works industry the following advantages: lower first cost; lower operating cost; freedom from maintenance troubles; absence of stuffing boxes; great flexibility and ease of installation; reduced weight; small, compact and cheap master control or clearwell control adjuncts; low air consumption; low wide open loss; wide range; and smoothness and accuracy of control beyond even the most exacting demands.

Pump Motor Starting Problems

by M. C. BOGGIS and E. O. POTTHOFF

Messrs. Boggis and Potthoff are Sewage and Water Works Application Engineers, General Electric Company, Schenectady, N. Y. In this article they discuss the several problems involved in determining the starting method to be employed in pump motor applications.

THE MAJORITY of pump motor applications in water and sewage plants do not involve a starting problem. Nevertheless, in many installations the torque requirements of the pump and the inrush limitations placed on the motor are such that careful investigation of the starting method is warranted to determine if satisfactory starting will be obtained. Typical of a problematical application might be a water booster station, likely to be located in a residential area and supplied with power from a residential feeder with attendant strict requirements to minimize voltage disturbance.

An investigation to determine the ability of a motor to break away the pump from standstill and accelerate to running speed should include consideration of motor and pump characteristics, types of starting equipment, and effects on the power system.

The proper selection of motor torques and starting method for a given application may involve a compromise between established load torques and inrush limitations. Pump starting torques, in most cases, are rigidly fixed for a given pump type, which in turn was selected to accomplish a specific hydraulic job. As will be shown, pump starting torques must not be arbitrarily considered inconsequential, because considerable variation in starting torques exists between different types of pumps and starting under different hydraulic conditions.

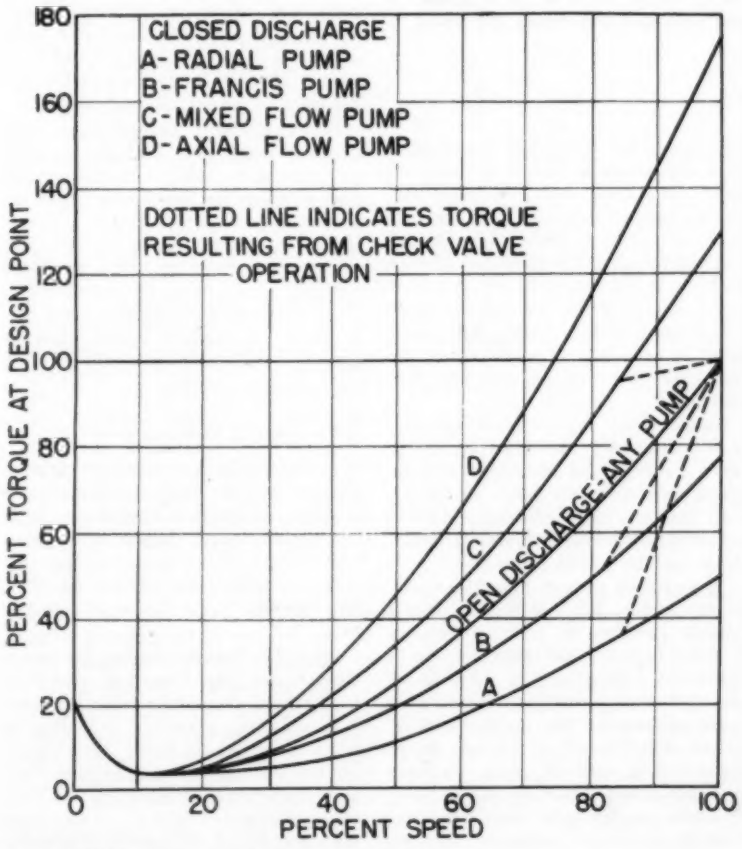


Fig. 1—PUMP starting speed-torque characteristics

Limitations on starting inrush may be placed by a power company or forced by local plant conditions. The latter is exemplified in the case of a station served by a "soft" power supply which would experience severe voltage dips when motors are started unless a reduced inrush starting method were used. The adverse effects of such voltage dips will be discussed later.

Briefly, the job of resolving a pump motor starting problem is covered by four points, as follows:

1. Determine specifically which pump starting characteristic is applicable. (Typical characteristic curves should not be used except on a preliminary basis.)
2. Determine if any starting current inrush limitations apply.
3. If a squirrel cage induction motor is best suited to the application, determine if it will accelerate the load while meeting any required current inrush limitation.
4. If chosen for other reasons, determine proper synchronous motor torque values or wound-rotor induction motor starting characteristics.

In this article characteristics of the following motors and pumps will be discussed:

1. Induction motors through 500 hp, 720 to 1,800 rpm.
2. Synchronous motors 200 to 3,000 hp, 200 to 1,800 rpm, 1.0 power factor.
3. Centrifugal and axial flow pumps under various discharge arrangements and conditions.

Pump Starting Characteristics

The starting speed-torque characteristic of a pump is governed by two

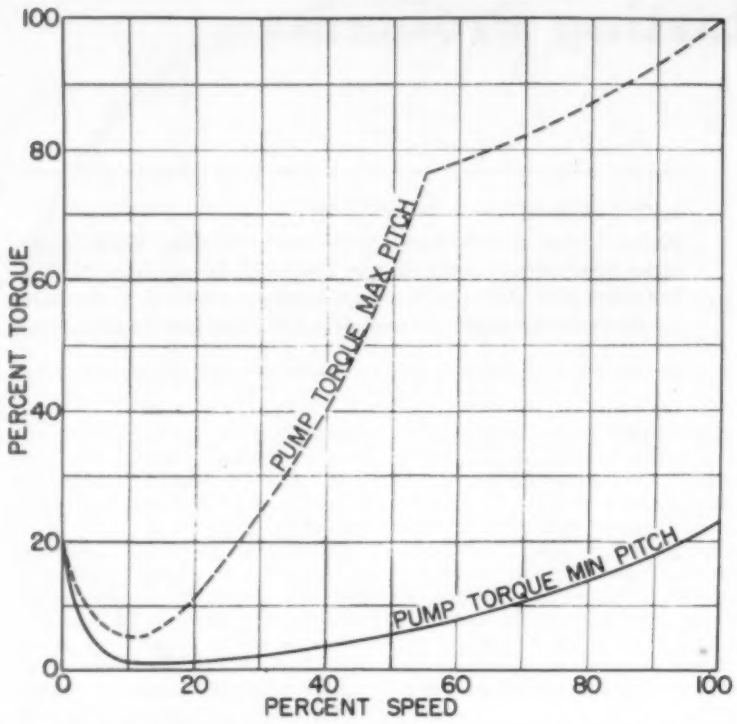


Fig. 2—TYPICAL CURVES showing starting speed-torque values of an adjustable pitch axial flow pump at both limits of impeller pitch and with tilting disc check valve in discharge line

factors—the type of pump impeller and the hydraulic conditions while starting. The latter includes an open or closed pump discharge valve, or dewatered pump casing.

Impellers can be classified on the basis of their performance and proportions regardless of actual size or their operating speed by the term "specific speed," commonly used among pump designers. This is defined as the speed at which the impeller, if reduced in size proportionately, would deliver 1 gpm at a total head of one foot. The mathematical expression for the term is:

$$N_s = \frac{N\sqrt{Q}}{H^{3/4}}$$

In which

N = speed, in rpm;
Q = capacity, in gpm;
H = head, in ft.

The starting speed-torque curve A (Fig. 1) is representative of a radial impeller pump (specific speed approximately 500 to 3,000) under closed-discharge conditions. The open-discharge curve is also shown. Although breakaway torque is the same for either discharge condition, a large difference in torque develops as speed increases with an open-discharge torque twice that of closed-discharge at full speed. The dotted line intersecting the closed-discharge curve at approximately 85 per cent speed represents the approximate torque load when a tilting disc check valve is used which opens when the discharge pressure exceeds the line pressure.

Curve B of Fig. 1 illustrates the closed-discharge speed-torque curve for a Francis-type impeller (specific speed approximately 1,500 to 4,500). Note that the closed-discharge torque values are somewhat higher than those for the radial impeller.

Mixed-flow pumps (specific speed approximately 4,500 to 8,000) pose a difficult problem in starting because of their high torque requirements at full speed. Curve C of Fig. 1 illustrates closed-discharge starting torques. This curve represents the upper limit of torque at full speed, which may range from 100 to 130 per cent. Because closed-discharge starting is the most common usage, care must be exercised in applying synchronous motors, particularly, due to the high pull-in torques (load-torque at approximately 100 per cent speed) required.

The axial-flow or propeller pump (specific speed approximately 8,000 and above) develops pressure head by imparting a helical motion to the fluid rather than by centrifugal force. The speed-torque curve in Fig. 1 (curve D) is representative of an axial-flow fixed-vane pump closed-discharge starting characteristic. The potential starting problem under closed-discharge conditions is obvious. These pumps are also available in an adjustable-vane construction which provides a range of capacity and head conditions using a constant-speed drive. The speed-torque curves of such a pump starting against a tilting-disk valve are shown in Fig. 2, for the vanes in both limits of pitch adjustment.

A siphon discharge arrangement is commonly used in large drainage pump installations. The siphon discharge configuration is shown in Fig. 3, along with a representative starting speed-torque curve. The curve has a reverse bend at about 80 per cent speed, when water starts to spill into the drop-leg of the siphon, and then drops abruptly to normal torque at full speed when the siphon is established. If a synchronous motor were used as a drive, the load torque to be pulled into step would be roughly 115 per cent of rated full-load torque.

Occasionally pumps have been started with dry casings so that torques can be reduced to a minimum. Fig. 4 shows the low torques that can be expected with such an arrangement. To start a pump with a dry casing obviously requires a closed suction, or it must be unprimed if there is no positive suction head and a source of cooling water must be provided for shaft seals and wearing rings during starting.

Motor Starting Characteristics

NEMA design B squirrel cage induction motor characteristics are standardized as to locked-rotor torque and current and maximum torque. For water and sewage pumping, motors conforming to NEMA design B have proven to be the most satisfactory.

In a synchronous motor the amortisseur winding (starting winding) is electrically separate from the main field winding, allowing its design to be modified within limits, thus changing the starting and accelerating characteristics without affecting the running characteristics. Lower than standard inrush current is obtained at the expense of lower torques through-

out the starting range, including pull-in torques; therefore, a realistic balance must be achieved in specifying high acceleration torques and low inrush currents.

Synchronous motor torques, suitable for a specific application, may be selected by dividing the required torques by the square of the ratio of actual voltage at the motor terminals to motor-rated voltage. The most significant pump torques are those at breakaway and approximately 97 per cent speed. The calculation of actual voltage at the motor terminals must, of course, include system voltage dip and any voltage reduction as the direct result of the starting method to be used.

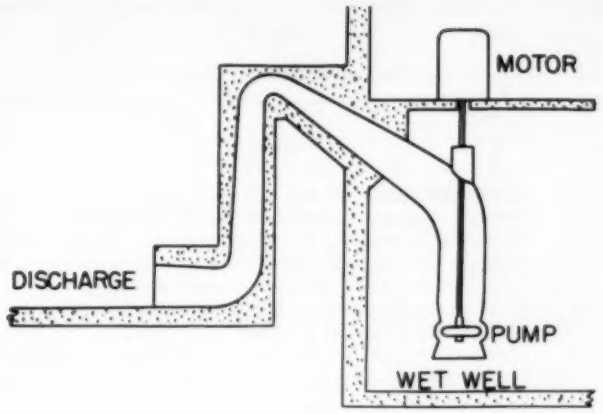
The curves in Fig. 5 may be considered typical of the starting characteristics of a low speed, vertical synchronous motor in a large rating. The torque curve shown represents air-gap torque through the starting range rather than shaft torque. This representation is desirable for vertical machines using plate-type thrust bearings, because the torque required by the thrust bearing is different at breakaway from that found during acceleration. The air-gap torque should be corrected for the actual voltage at the machine terminals and the torque required by the thrust bearing then subtracted to determine shaft torque. The thrust bearing will take approximately 25 per cent of full load torque at breakaway. The shaft torque and the air-gap torque are, for practical purposes, equal throughout the accelerating range.

In addition to breakaway torque, pull-in torque, and breakdown torque, there may be considerable significance in the actual values of motor torque at intermediate speeds, particularly in high-speed motors (1,800 and 3,600 rpm). A dip in the speed-torque curve, generally occurring at 60 to 80 per cent speed, may prevent acceleration to the desired speed. For this reason, the actual motor and pump characteristics should be used in a difficult starting problem solution rather than typical characteristics.

Wound-rotor motor starting characteristics are adjustable within wide limits of torque and current by the adjustments of external resistance in the rotor circuit. The percentages of torque and current at any particular starting step are approximately equal and are inversely proportional to per cent external resistance.

Objectives in Limiting Inrush

The need for limiting inrush on



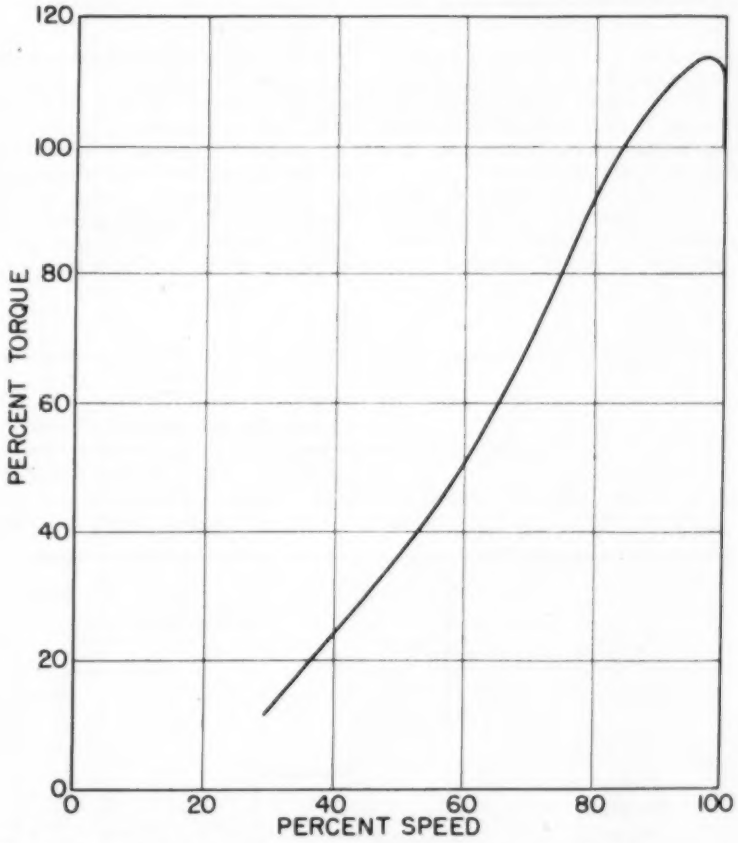


Fig. 3—STARTING characteristic of axial flow pump with siphon discharge

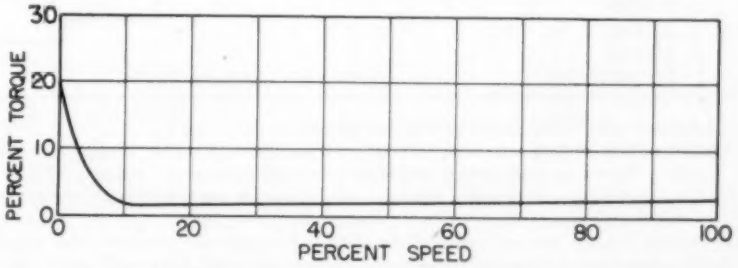


Fig. 4—REPRESENTATIVE speed-torque curve of pump started with dry casing

TABLE 1

Effects of Reduced Voltage Levels

Percent Voltage	Effects
97.5	Objectionable lighting flicker
90	Minimum operating voltage for high bay mercury lamps (sudden dip)
85	Minimum pick-up for low-voltage a-c contactors (up to NEMA size 5)
80	Minimum operating voltage for fluorescent lamps
76	115% loaded induction and synchronous motors stall
74	Minimum pick-up for high-voltage air break a-c contactor
70.5	100% loaded induction motors stall
70	Maximum drop-out for low-voltage a-c contactors (up to NEMA size 5)
67	100% loaded synchronous motors pull-out
53	Maximum drop-out for high-voltage air break a-c contactor

motor starting is determined solely by the amount of voltage disturbance allowable during a starting cycle. The interest in the voltage disturbance may be that of the local power company or of the power user.

The aims of an electrical utility company regarding voltage disturbance are, for the most part, concerned with lighting flicker. Starting inrush limitations should not be specific without reason; the power user is unnecessarily penalized costwise and, perhaps, performancewise if this occurs.

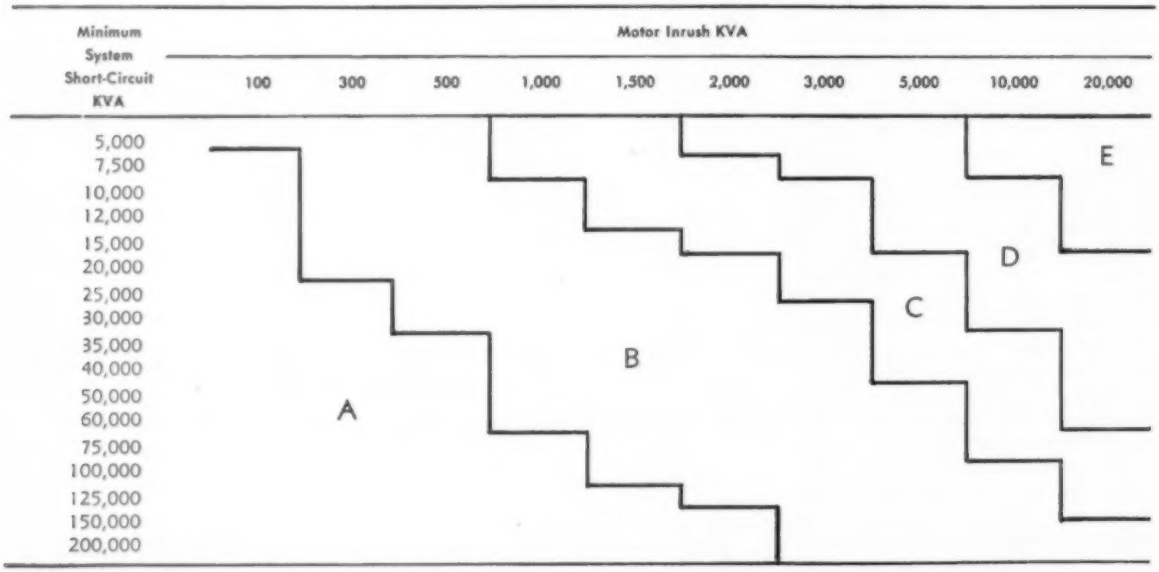
The user's objective in minimizing voltage disturbances within his plant are of a somewhat similar nature. Table 1 lists the various approximate voltage levels at which the corresponding effects will be experienced. The significance of the pick-up values for a-c contactors listed is in reduced-voltage starters where the running contactor coil must have the minimum voltage indicated to allow transfer to full voltage.

With the voltage levels listed in Table 1 as the criteria, Table 2 is an attempt to generalize on the need for reduced inrush starting on the basis of the voltage dip incurred on a system by a given motor starting power draw (kva). The suggested starting methods for the indicated areas must not, of course, be taken as the final word because of individual circumstances, but it may serve as a guide in establishing the need.

The need for reduced inrush starting equipment might also be affected by the point of measurement and calculation of the allowable inrush kva. If the interested power company specifies a kva inrush limitation measured at the line terminals of the motor starter with rated motor voltage at those terminals, the possibility of the need for special motor design or starting equipment is greater than if this measurement were made at the

TABLE 2

Need for Reduced Inrush Starting



A—Full-voltage starting should be used (voltage dip less than 1.5%).

B—Full-voltage starting acceptable from power consumer's standpoint (neglecting light flicker); power company acceptance dependent upon intervening transformers and other connected customers (voltage dip 1.5 to 10%).

C—Power company will probably insist on reduced inrush starting unless sufficient intervening impedance materially reduces voltage disturbance experienced in system (voltage dip 10 to 24%).

D—Reduced inrush starting desirable from consumer's standpoint unless no other connected load is involved (voltage dip 25 to 50%).

E—Unable to start (voltage dip greater than 50%).

primary side of the station supply transformers. The intervening impedance of the transformer acts as a starting reactor and may permit full-voltage starting equipment in borderline cases, or change the voltage tap required in a reduced-voltage starter. This is illustrated in Fig. 6.

Inrush Limitation Stipulations

Power companies may specify an inrush limitation in terms of amperes, kva, or percentage of motor full load current. An inrush limitation may be stated as an incremental value or as a maximum value drawn throughout the starting period. If, for example, a limitation of 2,000 kva is specified, the two possibilities of speed versus current are shown in Fig. 7. It is obvious that if the quantitative value of a "maximum value drawn" limitation is equal to the value of each increment in an incremental limitation, the "maximum value drawn" stipulation would be the more difficult to meet since it requires acceleration to a considerably higher speed before transition to full voltage than the incremental stipulation. An incremental starting stipulation must be further defined as to how the increments are measured; that is, are the increments cumulative at full value or are they

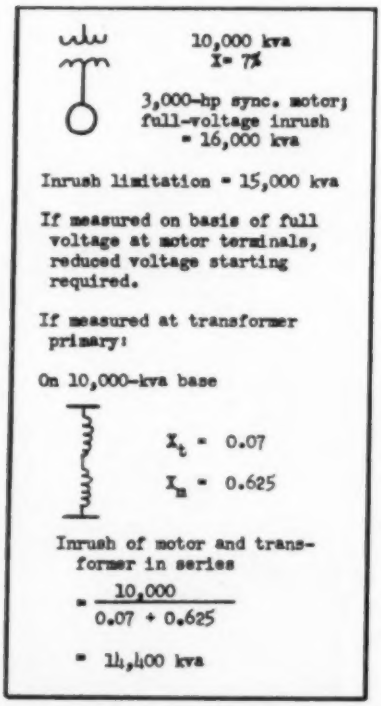

10,000 kva
X= 7%
3,000-hp sync. motor; full-voltage inrush = 16,000 kva
Inrush limitation = 15,000 kva
If measured on basis of full voltage at motor terminals, reduced voltage starting required.
If measured at transformer primary:
On 10,000-kva base
X_t = 0.07
X_m = 0.625
Inrush of motor and transformer in series
= 10,000 / (0.07 + 0.625)
= 14,400 kva

Fig. 6—EFFECT of point of measurement on inrush limitations

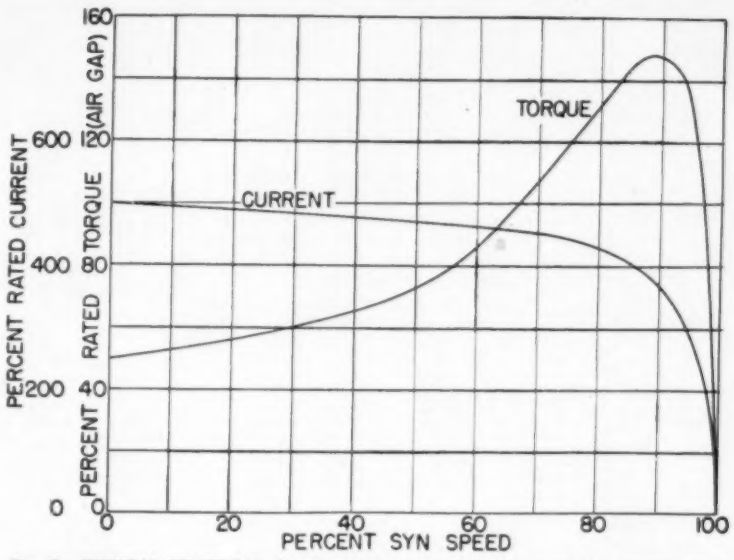


Fig. 5—TYPICAL STARTING characteristics of vertical, low-speed, 1.0 power factor, synchronous motor

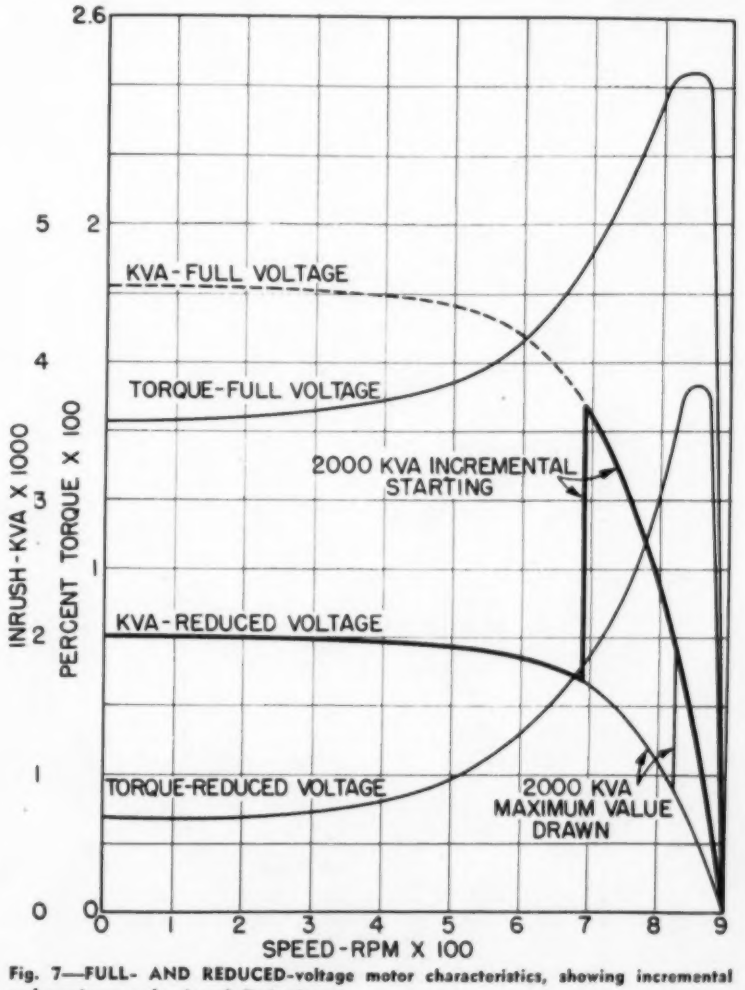


Fig. 7—FULL- AND REDUCED-voltage motor characteristics, showing incremental and maximum value inrush limitations

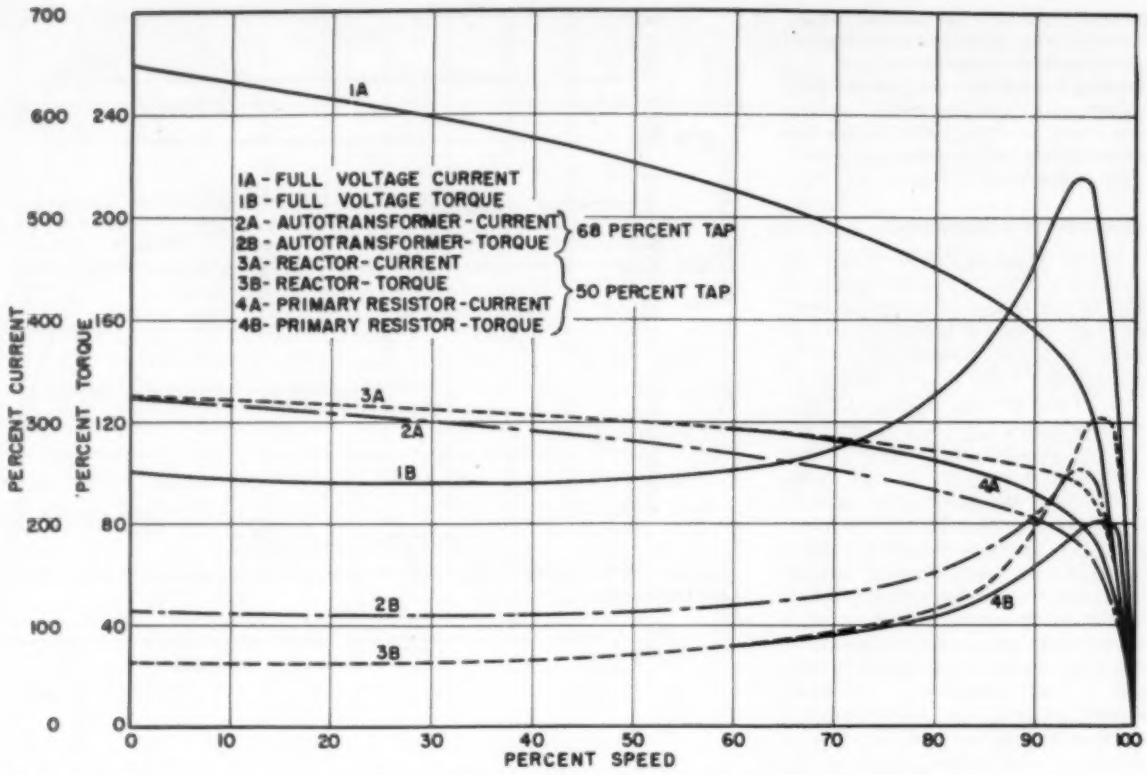

1A - FULL VOLTAGE CURRENT
1B - FULL VOLTAGE TORQUE
2A - AUTOTRANSFORMER - CURRENT
2B - AUTOTRANSFORMER - TORQUE
3A - REACTOR - CURRENT
3B - REACTOR - TORQUE
4A - PRIMARY RESISTOR - CURRENT
4B - PRIMARY RESISTOR - TORQUE
65 PERCENT TAP
50 PERCENT TAP
PERCENT CURRENT
PERCENT TORQUE
PERCENT SPEED

Fig. 8—EFFECTS on motor characteristics from various types of reduced-voltage starting methods

measured as increments above actual current at transfer.

It should be obvious from the foregoing that a clear, complete statement should be obtained from the power company involved on a specific job to define their current inrush limitation requirements.

Methods of Reducing Inrush

The distinct reduced inrush starting methods are:

1. Line-reactor.
2. Auto-transformer.
3. Primary-resistor.
4. Wye-delta.
5. Part-winding.

A variation of the line-reactor starter is the neutral reactor starter involving the connection of the external reactor and switching device in the neutral of the motor rather than on the line side. The advantage of this arrangement, discounting cost savings which are minor, is found in the greater flexibility in location of starting equipment compartments with possible space savings for a particular installation.

Open-transition auto-transformer starting, although generally acceptable and most commonly used, is sometimes found objectionable by electric utilities because of the momentary open circuit at transition to full voltage. This presents an occasional objectionable transient current peak during the switching operation. For this reason, auto-transformer starters are available in both open and closed (Korndorfer) transition designs. The Korndorfer starter requires (in addition to the 3-pole main line contactor) a 2-pole contactor and a 3-pole contactor in the auto-transformer circuit rather than a 5-pole contactor used in the open transition form. Consideration of auto-transformer starters should be limited almost exclusively to those applications involving contactor starting equipment because of the mechanical difficulties and high cost of providing the functional equivalent of a 5-pole switching device in a circuit breaker type of starter.

The wye-delta starting scheme, although not incorporating an external

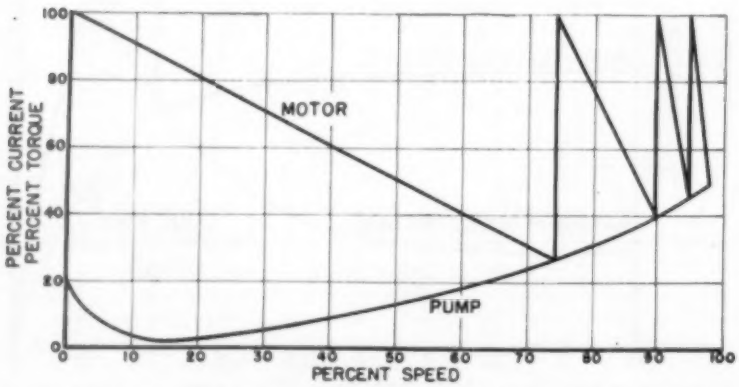


Fig. 9—CURRENT AND TORQUE characteristics of a wound-rotor induction motor accelerating a radial impeller pump

voltage dropping device, actually has reduced voltage applied to its phase windings by the wye connection for starting on a normally delta connected winding. This method, commonly used in Europe but seldom in this country, provides low torque on starting (about one-third of full voltage value) and no adjustment of the starting torque is possible after the motor is built. Because of this inflexibility it is not generally recommended. The current inrush upon transition to the delta connection may also be objectionable.

Part-winding starting is perhaps the most controversial starting method. The suitability of this starting arrangement must be reviewed for the specific application. In general, part-winding starting does not offer any advantages over reactor starting for the typical pump motor application. Some of the limitations of the part-winding starting method follow:

1. Starting torque efficiency varies with type and speed of motor. Low-speed synchronous motors will have essentially full voltage, full winding torque efficiency when started part-winding. Higher-speed machines have a torque efficiency similar to reactor starting.
2. Severe torque dips may be experienced during part-winding acceleration of some synchronous and induction motor ratings. This may even give the extreme results of negative torque in a portion of the speed-torque curve.
3. Thermal and mechanical stresses in the armature windings may be more severe than with full voltage, full winding starting.
4. Smaller wire size in armature coils is necessary in many cases, giving lower mechanical strength to the coils.

Better part-winding arrangements are possible if the number of magnetic poles in the motor is evenly divisible by 3 or 4. In addition, the horsepower rating, voltage rating, and number of starting steps required are very important.

The comparative effects on motor full-voltage starting current and torque characteristics by the use of auto-transformer, reactor and primary-resistor starters have been tabulated in reference material many times before. Fig. 8 shows the full-voltage starting characteristics of a 500-hp, 900-rpm, 2.3-kv, squirrel cage induction motor and corresponding resultant characteristics utilizing various forms of reduced-voltage starting.

Under conditions of extremely stringent inrush limitations where no other constant-speed motor and starter combination will solve the problem, the wound-rotor motor pump drive will always provide a solution. This drive offers unequaled starting torque efficiency, as shown in Fig. 9, which illustrates the current and torque vs. speed characteristic for a wound-rotor motor accelerating a radial impeller pump with closed discharge and drawing no more than rated current throughout the starting range. Higher current peaks will be obtained if a higher specific speed pump is used.

In those situations where it has been established that reduced inrush starting is required, based on a complete statement of inrush limitations, the determination of the optimum starting method must be made.

Based on motor starting characteristics of Fig. 8 and 10, and closed-discharge pump characteristics of Fig. 1, reactor and auto-transformer starting methods were evaluated as to their ability to start the motor with various inrush stipulations. The results are given in Table 3. The lowest percentage kva values permitting starting are listed, below which starting was impossible or very marginal.

The general conclusions which may be drawn from Table 3 are that (a) an auto-transformer starter will generally involve a lower demand from the power supply when starting a radial impeller pump and (b) a re-

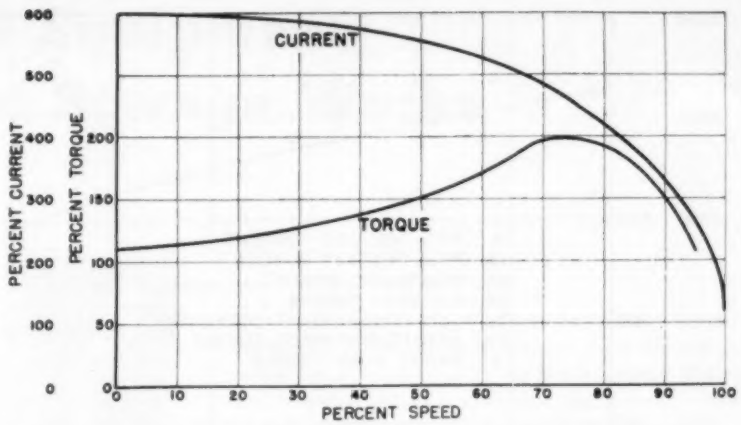


Fig. 10—TYPICAL full-voltage characteristics of high-speed synchronous motor

TABLE 3

Determining the Starting Method

% KVA Inrush Limitation	Synchronous Motor		Induction Motor	
	Mixed Flow Pump	Radial Pump	Mixed Flow Pump	Radial Pump
Max. value drawn:				
225	—	—	—	AT
300	—	R or AT	—	AT
325	—	R or AT	—	R or AT
400	R or AT	R or AT	—	R or AT
450	R or AT	R or AT	—	R or AT
520	R or AT	R or AT	R	R or AT
550	R or AT	R or AT	R or AT	R or AT
Incremental:				
220	—	AT	—	AT
300	R or AT	R or AT	AT	AT
325	R or AT	R or AT	R	R or AT

R = Reactor; AT = Auto-transformer.

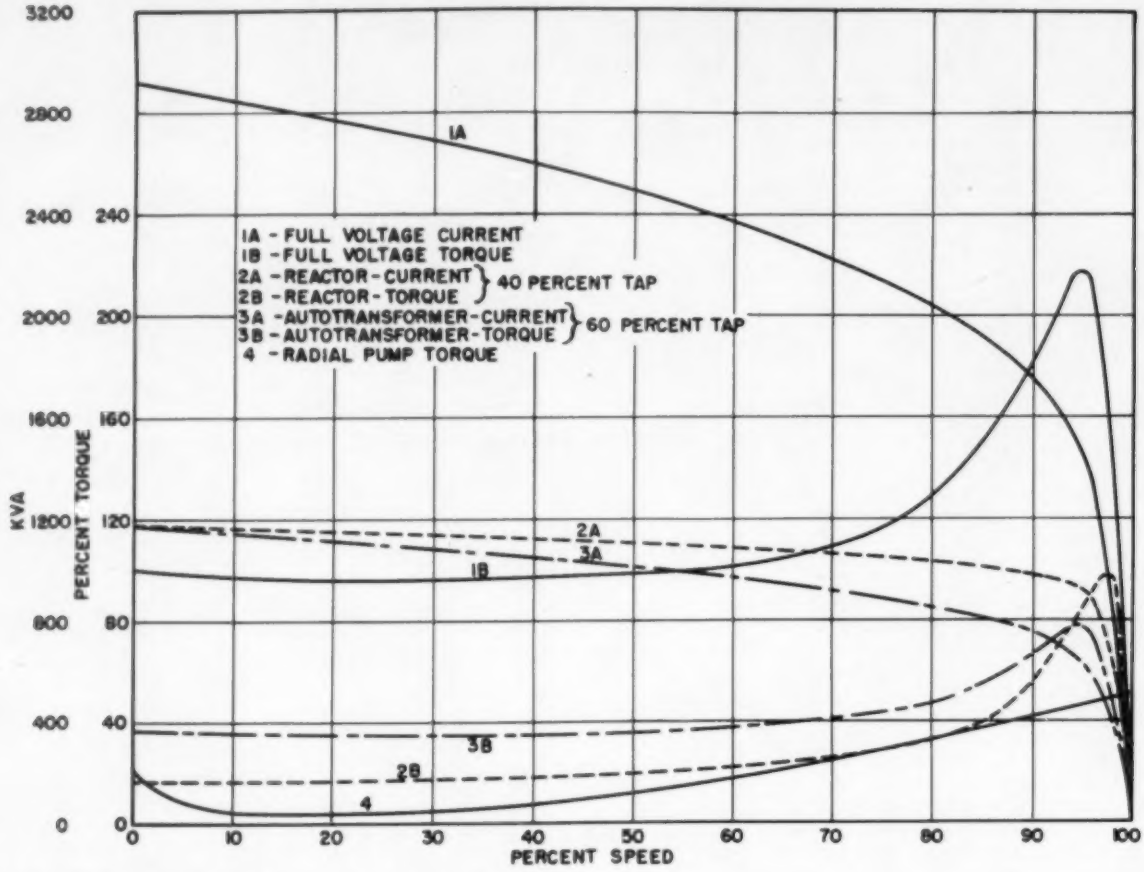


Fig. 11—MOTOR AND PUMP characteristics of typical problem

actor starter will generally afford the lowest demand when starting a mixed flow pump. There are exceptions to these conclusions which may be seen in the table, but in most cases the relative effectiveness of the two starting methods may be evaluated as stated.

Typical Problem

In order to illustrate the method of attack the following typical problem and solutions are given:

A municipality wishes to purchase a new pumping unit for an existing pumping station. The hydraulic requirements of the pump have been determined and an electric motor drive specified.

The 2,400-volt line feeding this station has a short circuit duty level of 100,000 kva and the starting inrush limitation is specified as 1,200 kva incremental.

A 500-hp, 900-rpm, horizontal, squirrel cage induction motor is required to drive the pump. The starting speed-torque curve is shown in Fig. 11, curve 4. Motor starting characteristics at full voltage are also shown in Fig. 11, curves 1A and 1B.

With this basic information it is possible to proceed with the selection of a suitable starting method.

It is apparent that full-voltage starting will not be acceptable because of the 650 per cent inrush current at full voltage. The full-voltage inrush of 2,920 kva must be reduced by a suitable starting method. The reactor starter involves the least additional expense over a full-voltage starter, so its use should be considered first.

The reactor tap required to meet an initial inrush of 1,200 kva is 1,200 ÷ 2,920, or approximately 40 per cent. The resulting speed-current and speed-torque curves are shown in Fig. 11. It may be seen that the torque provided by this voltage tap to break away the pump is inadequate and no higher tap may be used. The possibility of using a reactor starter is thereby ruled out.

An auto-transformer starter is the next best choice. This would require a tap of $\sqrt{\frac{1{,}200\text{-}100}{2{,}920}}$, or approximately 60 per cent. The 100 subtracted from 1,200 kva is the magnetizing kva drawn by the auto-transformer, usually estimated as 25 per cent of the motor full-load kva. The resulting torque and current curves using a 60 per cent auto-transformer tap are also shown in Fig. 11. Transition to full voltage at 98 per cent speed incurs a 400-kva inrush increment, which is well within that permitted by the power company.

Conclusion

Although the majority of pump motor drive applications do not involve a starting problem, this does not discount the need for careful investigation of those applications in which inrush limitations are stringent and/or load torques are severe. There exists a considerable number of variables in these two factors which must be crystallized before the optimum solution can be reached.

Lubrication of Equipment For Water and Sewage Works

by EDW. A. TSCHIDA

Mr. Tschida until recently was Superintendent of Water and Sewerage, Dickinson, N. D. In this paper, presented at a meeting of the North Dakota Water and Sewage Works Conference, he reviews some of the fundamentals of lubrication and cites experiences at his plants.

SEVERAL THOUSAND YEARS AGO grease was used to lubricate the axles of Egyptian chariots. Samples of this grease, which was made with an animal oil, have been found in Egyptian excavations. During the Italian Renaissance, Leonardo da Vinci used grease mixtures for the lubrication of some of his remarkable inventions. Later, greases were used on the first crude steam engines and power driven machinery, which started the Industrial Age in the 18th Century.

Early American greases were made in open kettles suspended over an open fire. Crude petroleum and resin were stirred together and when the maker thought the mixture was hot enough, he stirred in a solution of milk of lime until it was thickened to suit him. These greases reflected the competency or incompetency of the maker and were far from being uniform in consistency, structure, or in fact characteristic.

Grease is a mixture of petroleum oil and soaps formed together into a plastic structure. It must be used to lubricate bearings where oil cannot be retained long enough to provide lubrication. Present-day greases are manufactured by scientifically controlled processes. Extreme accuracy of temperature control, exact weighing and measuring, and extensive mechanical developments make close control possible. All this is done to overcome friction, such as metal to metal contact.

What Friction Is

Friction is defined simply as resistance to motion. Suppose, for example, that two flat metallic surfaces rest one upon the other. It would appear that smoothly ground surfaces such as these would offer little or no resistance to the movement of one another. When these surfaces are greatly magnified, however, they are found to comprise innumerable microscopic irregularities, such as hills and valleys.

The interlocking of these irregularities produces a definite resistance to the motion of one surface over the other. The force necessary to start this movement is great. After the movement is once underway the force required for continued motion is smaller because inertia prevents the moving surface from dropping again into an interlocking position, and momentum carries the hills of the moving plate over the corresponding hills on the stationary plate. This is the condition that exists in a slide bearing operating without a lubricant.

The primary purpose of oil or grease lubrication in plain bearings is to introduce between moving metallic surfaces a fluid or plastic medium in the form of a lubricating film which separates the surfaces sufficiently to prevent metallic contact. This lubricating film substitutes fluid or plastic friction, which is the friction within the film itself, for harmful metallic friction.

Action of Lubricant

Lubrication of ball and roller bearings is a special case of grease lubrication. Their requirements are different, and they are considered separately. Ball and roller bearings offer less resistance to starting motion than do plain bearings, and are therefore known as anti-friction bearings. The lubrication of such bearings is entirely different from the lubrication of plain bearings, since the motion is theoretically of a rolling nature.

If the motion in this type of bearing were actually purely rolling in nature, the roughness of the contacting surfaces would offer practically no resistance to relative motion. In other words, if the theoretical "point contact" between balls and races could be maintained, no friction could be present. Similarly, if the theoretical "line contact" between rollers and raceways actually existed during operation, the resistance offered to the movement of the rollers would be negligible. In each instance, however, the slight deformation of the balls, rollers and raceways results in an appreciable area of surface contact and consequent slippage, and friction, between the moving parts. Additional friction is encountered between the balls or rollers, and their cages, consequently even in anti-friction bearings there is a certain amount of slippage, although the friction resulting from such is relatively small.

The dual purpose of lubrication in anti-friction bearings is to protect the highly polished and accurately ground surfaces from rusting and corrosion, and to minimize the friction resulting from the contact and slippage between moving parts. This is accomplished by the use of a lubricant that coats the balls, rollers and races with a protective and lubricating film.

The severe churning of the grease by the balls and rollers tends to introduce air into the lubricant. Where inferior products are used, this action swells the volume of the grease, impairs its behavior, and results in unsatisfactory lubrication. Therefore, suitable greases for anti-friction bearings should resist aeration to a maximum degree, and thus minimize loss of lubricant. A high quality grease will be found to possess a maximum resistance to oxidation, separation and aeration.

To insure a complete lubricating check, at the author's plants a chart is made up on a six-months basis showing each motor, gear reducer, pump, compressor, exhaust fan, etc., together with the type of oil and grease to be used. The chart also contains space for indicating the date and the person

making the lubrication change on each machine. It is well to have one man take care of this very important assignment, because otherwise it is too easy to "pass the buck" when something goes wrong. Extending this lubricating program to six months seems like a long time between oiling and greasing, but during this period everything is checked once a month and oftener for possible loss of oil or grease. Such equipment items as chemical feeders, motors, and moving parts, are constantly being watched for lack of lubrication.

A minimum of three kinds of oil and three kinds of grease is used at the sewage plant and a minimum of two kinds of oil and grease at the water plant.

When the new water plant began its operation in May 1952, a lubrication Engineer from one of the major oil companies went over the entire plant, and drew up a chart with lubrication recommendations. The speed of all the motors is 1725 rpm and a No. 3 grease was recommended for ball and roller bearings and a medium-grade oil for practically all of the plant's oil needs.

Many motors now in use have what the manufacturer calls a "life-time" bearing on small motors, and bearings designated as high as five years on large motors, such as the 125-hp motor used for pumping at the Dickinson plant. This motor has sealed bearings, and the manufacturer has a nameplate on it specifying a five-year limit for an almost continuous service. It is hard to imagine a machine running constantly for five years with no bearing wear. It makes the ordinary layman wonder just where he's been all these years.

Gear Lubrication

In the earliest machines that man built to do his work, gears formed an essential part. The teeth of these early gears were pegs, fashioned out of wood, and inserted in the rims of wooden wheels. They were crude affairs. The loads that were transmitted were necessarily light, and speeds were low. Lubrication was of little concern then, for when a tooth wore or broke its replacement was a simple matter. The first big forward step in gear design came when peg teeth were abandoned, and teeth shaped much like those in modern gears were developed.

With this advance, lubrication assumed an important role in reducing wear and prolonging the life of the gear. Here, too, metallurgy had developed, and correct profiling and proportioning of gear teeth came into its own. Thus, present-day gears, with their accurately cut teeth of correct profile and finely finished surfaces, are a far cry from the old wooden pegged gears of the past. Many types of gears are currently used, such as the spur gear, stepped gears, helical gears, hypoid, bevel, worm, and many other types of gears.

At the Dickinson sewage treatment plant, there is a double-throated worm, and worm gear, in the primary clarifier; also in the secondary clarifier and in the digester. These sets of gears power the gathering mechanism that collects the sludge to be drawn off by the sludge pump and put into the digester. All teeth contact to full depth and all the teeth of the worm are in working contact simultaneously, with the result that these gears have a considerable area of tooth contact. The worm gear is partially submerged in an oil reservoir, and supplies its lubrication in this manner during operation. A glass oil container is used as an oil feeder; the operator can see when a refill is needed.

During the spring cleanup, the gear mechanisms of the primary, secondary and digester are completely taken down in search of any faulty parts that may cause a shutdown at some time or another. After every part is cleaned and inspected and reassembled, the reservoirs are filled with oil, and the gears are completely oiled by hand so as to avoid any metal to metal wear at the beginning of the operation.

The sludge pumps are packed when needed, and this is not too often. The operator keeps a soluble oil mixed with water over the packing at all times for smoother operation. Many different kinds of oil have been tried for this particular operation until the oil exactly fitted to the particular use was found.

If at any time there is a breakdown and a motor or pump is taken down, it is well to take advantage of the situation. If time is available, here is a chance to clean the bearings or repack the pump, and perhaps re-align the motor and the pump shaft. Shaft alignment is of great importance. No matter how small or how large a pump or motor may be, there is always a chance that it may be out of line. Any mechanism out of alignment means wear and tear on the bearings.

In going over the manufacturer's recommendations on oiled ball bearings, and also on gears encased in a housing with a sightglass inserted, their instructions specifically recommend that during a shutdown period of any length of time, the sightglass should be filled to the very top and left that way until operation is resumed. Furthermore, the sightglass reads maximum and minimum; when operating, the oil level should be kept midway. The reason for recommending a full sightglass during a shutdown period is that when machines are left idle during a shutdown period with the oil left midway in the sightglass, the upper half of the bearing is left exposed to moisture, and the balls may become pitted. One little pit in one ballbearing may cause trouble in the future.

Small Motors

Lubrication of fractional horsepower motors should be mentioned. Most small motors have a small felt pad that feeds the oil to the motor shaft. After it has been run for some time this felt pad hardens and completely shuts off the oil feed to the shaft. In order to get the oil flowing freely again, a sharp instrument such as a dental tool is used to pierce the felt wick several times until the oil flows freely. About 99 per cent of all small motor trouble is caused by lack of lubrication and over-fusing.

In conclusion, it should be stressed that correct lubrication involves the application of the right lubricant, at the right place, in the right way. It follows that there should be a right lubricant for every type of machine made. The oil industry has found these correct oils and greases for every possible mechanism. It is a good feeling to know that lubrication specifications have been simplified by the oil industries to the extent that an expert can be called to give his recommendations, free of charge, whether it be for the simplest piece of mechanism or for the most intricate machine used in science.

"True, the city water pressure may be a little weak up here at times: but, you'll never be troubled with the sewer backing up into the basement."

Requirements for Establishing Industrial Waste Ordinances

by DEAN M. TAYLOR

Mr. Taylor is Senior Sanitary Engineer, Engineering Division, Department of Public Works, Cincinnati, Ohio. In this article, presented at the 10th Purdue Industrial Waste Conference, he discusses the policy, legal, financing, engineering and technical requirements inherent in establishing ordinances for the control of industrial waste discharges to municipal sewers.

INDUSTRIAL WASTES and domestic sewage are two of the principal causes of the recognized water pollution problem in this country. Both types of wastes are man-made and can be controlled.

Industrial wastes discharged to public sewers constitute a large proportion of the total flow from industry. It is this segment of the total which can be controlled on a local level by the rules and regulations commonly known as industrial waste ordinances.

Most industries in this country are located in or near political subdivisions which have sewer systems. A U. S. Public Health Service report[1] stated that there were 11,811 municipalities having sewer systems, with about 56 per cent having sewage treatment plants, most of which were receiving industrial wastes to some extent. A survey by the National Association of Manufacturers of more than 3,000 industries indicated that 69 per cent of the industries discharged all or a part of their wastes into municipal sewage works. These facts point to the common problem facing industries and municipalities in waste disposal.

Industry naturally wishes to dispose of wastes at the lowest possible cost. This can usually be done by discharge to the municipal waste disposal system. Most industries in incorporated areas feel that it is the responsibility of municipal government to dispose of their water-carried wastes. Most municipalities are willing to accept this responsibility, provided the industrial wastes are acceptable for discharge to the municipal sewage disposal facilities. When the quantities of industrial wastes are much greater than those of domestic sewage, there are usually problems of jurisdiction and cost. These problems, however, can be solved with equity.

Every industry has the option of treating its own wastes and discharging them to public watercourses. It then becomes the duty of water pollution control agencies to determine whether or not the effluents meet accepted pollution standards. If industrial effluents do not meet established standards for discharge to waters of the State, the City of Cincinnati, Ohio, applies the same sewer charges as are applied to wastes going into public sewers.

If it is agreed that industrial wastes are to be discharged to public sewers, it then becomes fitting and proper to adopt rules and regulations governing the use of the public sewer system. "Manual of Practice No. 3"[2] of the Federation of Sewage and Industrial Wastes Associations states that every municipality should adopt a suitable and complete ordinance, fitted to local conditions, for the control and regulation of the use of public sewage works. It gives reasons for municipal sewer ordinances, details of ordinance composition, and a model ordinance. This model ordinance is of the so-called "long" type, which includes the detailed requirements for compliance. The manual gives very good coverage for a municipal sewer ordinance; many people would be satisfied with it for an industrial waste ordinance, because it does discuss industrial wastes in the section on "Regulation of Waters and Wastes Admissable to Public Sewers." The author, however, does not consider this model sewer ordinance as satisfactory for an industrial waste ordinance because there is no consideration of financing. The Industrial Wastes Committee of the California Sewage Works Association[3] went so far as to state that the whole matter, in the final analysis, is one of cost of disposing of troublesome industrial wastes and of who shall pay the price. It is unrealistic to ignore costs of handling industrial wastes when establishing industrial waste ordinances.

Establishing an industrial waste ordinance is no simple task. When one begins to consider all the different situations that may exist in different communities, it is realized that there is no single industrial waste ordinance, per se, for all conditions. The Industrial Wastes Committee of the California Sewage Works Association states[3] "no fixed policy can be set up for all cities to follow in connection with the treatment and disposal of industrial wastes. There are entirely too many factors involved in different cities to make one rule applicable to all."

Probably the best procedure is to first form a committee which includes those people best qualified to deal with the subject. It is important that both industry and municipal government, including the people required to administer the ordinance, be represented. Industrial waste ordinances have failed to pass in certain cities simply because governmental officials failed to take industry into their confidence. The committee can get all the facts, study them, evaluate them, and draw up an ordinance according to the best principles of practice. Various committees on a professional level in the fields of engineering, law, finance, and government have been giving this subject serious consideration in the last few years. The common exchange of ideas has been beneficial in establishing some basic fundamentals which should be studied and discussed by all those concerned with the subject.

The question of what should be included in an industrial waste ordinance is controversial. "Manual of Practice No. 3"[2] states that sewer ordinances used in municipalities of small and moderate size are usually self-contained in that they encompass all elements of control, including the detailed requirements for compliance. This is called a "long form" of ordinance. The Manual also states that in some large cities only a simple instrument is used, with the person or department administering the ordinance given the power to develop detailed rules and regulations, setting forth the specific requirements to be

met. The short form of ordinance is used by Detroit, the Boston Metropolitan District Commission, the Sanitary District of Chicago, and the Milwaukee Sewerage Commission.

The author prefers the short form of ordinance because of its greater flexibility and ease of application. Councils and Commissions are usually unfamiliar with the technical details of an industrial waste ordinance and consequently are reluctant to make any changes, regardless of need. When the professional person or persons administering the ordinance sees the need for changes in the rules and regulations which he or they have set up, it is a relatively simple procedure to make the desired changes or additions.

The Industrial Waste Ordinance of the City of Cincinnati, Ohio, for the Metropolitan Sewage Disposal System is a short form of ordinance, with provision for separate rules and regulations controlling discharge to public sewers. It was passed in 1953 to supplement the original sewage disposal ordinance of 1948 which was passed by City Council to provide funds for the Metropolitan Sewage Disposal System of Cincinnati; and to fix rates to be charged by the city to the owners of benefited property for the use of the sewer system and sewage pumping, treatment, and disposal works. When it was realized that the sewage service charge rates, on a volume basis, were inadequate to pay for the increased construction, operation and maintenance costs, two additional ordinances were passed in 1953. The Sewage Service Charge Ordinance modified the original ordinance by increasing rates on a volume basis. The Industrial Waste Ordinance supplemented the original ordinance by establishing rates of surcharge for wastes greater in strength, on a suspended solids and B.O.D. basis, than a defined "normal sewage" (300 ppm suspended solids and 240 ppm B.O.D.). The Rules and Regulations have been amended twice since their adoption in 1953 to remedy technical discrepancies.

Certain phases of industrial waste ordinances are fundamental, such as policy, legal requirements, financing and engineering requirements.

Policy

Policy should be established as quickly as possible because success is difficult without clear-cut plans. The initiative in establishing industrial waste ordinances usually falls on local government. If an industry is discharging its wastes to public waters, it will not be particularly interested in an industrial waste ordinance unless water pollution regulations are threatening its methods of waste disposal. If an industry is already discharging its wastes to public sewers, it will be reluctant to promote a program costing more money. Consequently, when local government is faced with the problems of water pollution regulations, it must initiate proper waste disposal methods, including considerations for industrial wastes.

If local government has a sewer system but no treatment facilities, it will sooner or later probably have to install proper treatment facilities. If it had no sewer ordinance previously to protect its sewer system, this need should become apparent when applying rules for discharge to protect treatment facilities. Moreover, it may need restricting regulations to meet effluent or stream standards.

The question of whether or not to accept industrial wastes into municipal waste disposal systems depends largely on local conditions. The relative volumes and strengths of domestic and industrial wastes vary considerably. The relative economic importance of an industry or industries in small communities often makes a big difference. It is generally agreed, however, that, except for accepted technical reasons, domestic and industrial wastes can be treated together in one system. If certain industrial wastes cannot be treated to the point of acceptance for treatment in the municipal system, they will have to be excluded.

If it is agreed that admissable industrial wastes will be handled in the municipal system, it is practical and realistic to provide for the cost of same in an industrial waste ordinance. The cost of handling industrial wastes will have to be met one way or another and it might as well be on an equitable basis. When industry and government work out the solution together, they can understand each other's problems and usually come to some common plan for financing.

The Cincinnati Industrial Waste Ordinance supplements the original sewage disposal ordinance, which established the sewer service charge to finance the sewage disposal program. It provides for a surcharge on industrial wastes which impose an unreasonable burden upon the sewage disposal system greater than average or "normal" sewage. It also prohibits any wastes which will damage the system or cannot be treated satisfactorily.

The Cincinnati Industrial Waste Ordinance was the result of many meetings with representatives of industry and public hearings. The Cincinnati Chamber of Commerce played an important part in bringing out the interests of everyone concerned. It is actually stated in the ordinance that the City of Cincinnati, in response to the request of industry, will build sewage treatment facilities capable of treating admissable industrial wastes in excess of "normal" sewage. It also states that industry has agreed to pay for those costs additional to treating "normal" sewage.

Legal Requirements

There are certain legal requirements for industrial waste ordinances. Laws vary from state to state and ordinance committees should seek legal advice to avoid mistakes which will hinder or even prevent the development and adoption of desired ordinances. All states have laws permitting political subdivisions to adopt ordinances complying with existing laws. Cities have had the greatest latitude over the years, but recently smaller communities and unincorporated areas have been given more administrative powers. More recently some states have passed laws providing for the incorporation of authorities for municipalities, counties, and townships.

Such authorities are authorized to acquire, construct, improve, maintain, and operate projects; to borrow money and issue bonds; to provide for the payment of such bonds; to establish rates for revenue, etc. Geographical or other special considerations may make desirable joint participation by adjoining municipalities or suburban areas. This may be achieved through the establishment of special districts for sewage purposes, covering an appropriate service area, or by functional consolidation.

For very practical reasons, procedures for establishing fair rates and rate structures should, so far as possible, be applicable to existing methods of financing under existing enabling acts or should point the way to statutory changes or innovations.

Charges for industrial wastes are usually based on sewage service charges or surcharges, and special financing agreements. Consequently, it is important to be familiar with all state financing laws and local regulations.

In most states, the issuance of general obligation bonds by local units of government is subject to limitations, sometimes constitutional, sometimes statutory, and usually expressed quantitatively by reference to assessed values of taxable property. Special assessment bonds are issued only where certain properties are recipi-

ents of special benefits not accruing to other properties. Special assessments may be levied by most municipalities and by municipal districts, commissions, and other types of local bodies, as may be authorized by statute.

Generally speaking, revenue bonds may be supported by a pledge of revenues received from operations in any legitimate area of operation, whether within or without the geographical limits of the borrowing unit. There is generally no legal limitation on the amounts of revenue bonds which may be issued; the limit is not legal, it is economic. Attention is called to the fact that the power to issue revenue bonds depends upon delegation by positive law. The courts of certain states have placed constitutional debt limitations on revenue bonds, holding that any particular issue of revenue bonds does not escape limitations unless they are to be paid solely from the revenue of the particular improvement. This is the "limited special fund theory," as opposed to the more generally accepted "broad special fund theory."

Many enabling acts prohibit the diversion of sewage income to other activities. The Pennsylvania law authorizing sewage charges requires that any surplus above a 10 per cent margin of safety be placed in the sewage sinking fund and forbids any transfer of funds to the general municipal funds. Unless the statutes prevent such a covenant, the municipality can agree to apply all surplus revenues not required for operation and maintenance, bond service, and the other funds provided for in the bond proceedings, to the redemption of its revenue bonds through call or purchase prior to their maturity as rapidly as surplus funds are available for that purpose. The Constitution of New York forbids the Legislature to prohibit municipalities from using profits from their public utilities for municipal purposes or for refunds to consumers.

Some state laws specify the purposes for which sewage charge revenues may be expended. New York and Ohio provide that revenues must be used first to operate, manage, and maintain sewers and treatment plants, and any surplus may be used for enlarging existing structures or for debt service. The statutes of both states specifically forbid the use of sewage charges for extending sewers into previously unsewered areas.

Financing

The Ohio River Committee[4] appointed by the Secretaries of War and the Treasury, according to the River and Harbor Act of August 26, 1937, reported in 1943 that the principal obstacle to the abatement of pollution is the actual financing of the necessary facilities. It is inevitable that people drawing up ordinances will be confronted with this problem. Some will say that it is the crux of the whole subject. So many plans have been proposed that there is little wonder that municipal officials and industries experience difficulty in approaching the problem. Too often fundamental considerations are lost sight of and expediency and the path of least resistance become deciding factors.

The most comprehensive report to date on fundamental considerations in rates and rate structures for sewage works is the Joint Report[5] of Committees of the American Society of Civil Engineers and the American Bar Association and representatives of six other organizations. The basic conclusion of this report is that both users and non-users should contribute to the needed total annual revenue approximately in proportion to the cost of providing for the use and for the benefits received. Schroepfer[6] has applied the Joint Committee recommendations to an illustrative example.

It is no simple task to apply the Joint Committee recommendations for fair sewage service charges. It is fundamentally one of first determining the total annual revenue requirements and distributing the costs in proportion to benefits and use. Costs for industrial wastes should be figured in with all other costs and then distributed accordingly.

Annual charges can be based on costs for (a) collection system; (b) intercepting sewers, including pumping stations; and (c) treatment facilities. The revenue requirements for these units are usually divided among (a) fixed charges or debt service, (b) operation, and (c) maintenance and replacement. After plans for the waste disposal system have been established, the first step would be to calculate the fixed charges for each unit of the system. It will be more difficult to estimate the operation and maintenance costs and they may have to be revised after operation data have been obtained. It will also be necessary to make allowance for such overhead costs as collection of revenue, field investigations, sampling and gaging of industrial wastes, laboratory analyses, administration, etc.

The allocation of costs is more difficult. Both property and the user are responsible for certain items of costs. It is reasonable to say that storm water, ground water, public use, and future use are chargeable to property. The charges to users are based on the characteristics of wastes discharged to the system. The relative proportions of costs to property and users will vary in the different units of the system. The size and cost of collecting sewers and intercepting sewers are caused wholly by the quantity of sewage. The percentages for pumping stations are based mainly on quantities with due regard for that part of the cost of screens and screening disposal facilities caused by use and by storm water; and to the wearing of pump parts by grit in storm water.

In the treatment plant, the percentages caused by use and by property depend on both the quantity and the characteristics of the sewage. A study of the costs of various parts of each major part or function is required. Thus, the cost of screens and grit tanks is attributable mainly to grit and storm water from property. Sedimentation costs are affected principally by volume and chargeable to both property and users. On the other hand, the costs of secondary treatment and sludge disposal processes are caused largely by users.

After costs have been allocated, rates and rate structures can be established. Property costs are usually paid by general property taxes, although front footage or area rates may be used. Since costs to users are based on both volume and strength of wastes, it is reasonable to base revenue rates on these same indices. Many municipalities have revenue rates based on volumes, but very few apply rates based on strengths of wastes. It is a relatively simple matter to apply volume rates because the water departments have water consumption records and private wells can be metered. It is impractical, however, to try to determine the strengths of all wastes. It is more practical to establish a service charge based on volumes of a so-called "normal" sewage and then apply a surcharge on all stronger wastes. Surcharge rates should be clearly defined. They may be expressed by formulas, but it is simpler to use rates per pound of each chargeable constituent.

In relatively small communities, agreements are often made with industries to pay for industrial waste disposal costs. Payments may be in the form of lump sums, fixed annual amounts, or compensation on a percentage basis.

The important thing to remember is that there is a definite cost for handling industrial wastes. This cost must be paid for and those parties responsible for financing should make every effort to work out equitable charges.

Cincinnati employs a combined method of financing sewage disposal facilities. Collection sewers are financed by general obligation bonds, whereas street sewers are paid for by special assessments on a lineal foot basis. The intercepting sewers, pumping stations, and treatment plants are financed by mortgage revenue bonds, revenue for which is obtained from both a service charge on normal sewage and a surcharge on wastes greater in strength than normal sewage. Both the service charge and the surcharge rates are subject to review at least every five years.

Rates are the same to all users in the Metropolitan District regardless of whether or not they are in the city limits of Cincinnati. Charges for industrial wastes were determined by the incremental method. The additional cost for handling wastes stronger than normal sewage were calculated. Then the annual charge for industrial wastes was estimated and a formula developed to produce the necessary revenue.

In connection with revenue charges, it might be well to point out a method employed by Cincinnati to encourage cooperation of industry. Provision was made in the industrial waste ordinance for agreements between the city and industries, whereby the industries could obtain refunds if they signed agreements within six months after the effective date of the ordinance to install pretreatment facilities within twelve months after the collection of the sewerage surcharge became effective. The refunds were based on reductions of strengths of wastes, and applied to wastes discharged to both the public sewers and public waters. These special sections were actually bonus clauses to industry for initiating waste treatment facilities.

Engineering and Technical Requirements

There are many engineering and technical questions to be answered before an industrial waste ordinance can be established. Even though such an ordinance is concerned primarily with industrial wastes, it is necessary to have certain data on the whole sewage disposal system. Not only must the characteristics of the industrial wastes be known, individually and collectively, but also the characteristics of all the other sewage discharged to a common treatment plant or plants. Having determined the characteristics of total wastes to be treated, it is necessary to determine the degree of treatment to meet effluent or stream standards.

After total costs of construction, operation, and maintenance have been estimated, rate schedules must be calculated to meet revenue requirements for the industrial wastes. In addition, it will be necessary to make technical decisions regarding admissability of wastes to public sewage disposal systems. Many municipalities retain consulting engineers to work out all the engineering problems; others retain them to work with their staffs. In any event, it is always practical to have experienced engineers review the technical plans.

Engineering studies must include not only investigations of present wastes but also reasonable predictions of future ones. Topographical surveys should be made to determine future trends of industrial and residential growth and properly locate intercepting sewers. It will be necessary to gage and sample the sewage at representative points in the collection system in order to determine the characteristics of the wastes discharged to treatment facilities. Pollution surveys should be made on the receiving stream before the degree of treatment is determined. The question of having more than one treatment plant must be answered, as well as the types of treatment units. The choice of plant location may require considerable study.

Rules for prohibiting certain wastes from the disposal system should be established at the time the ordinance is presented for approval, so that all parties concerned will understand the conditions. Certain wastes should be prohibited for four reasons:

1. To protect the collection system.
2. To protect the treatment plant.
3. To meet effluent or stream standards.
4. To protect personnel.

The prohibitions may apply to the wastes at their source, after they reach the plant, or as they discharge from the plant. For example: acid wastes should not be discharged to sewers because of their destructive action on the materials of construction; excessive quantities of certain metal salts should not be admitted to treatment plants because of their toxic action on treatment processes; and excessive quantities of soluble fluorides should not be discharged from treatment plants because of their effect on downstream public water supplies.

Considerable thought should be given to the rules for admission of industrial wastes to sewage disposal systems. It is not wise to adopt certain rules simply because they are in some other ordinance. Too often these rules are simply hand-me-downs and may be out of date or non-factual. When they are placed in the ordinance proper, they are usually expressed in general terms. When they are placed in the rules and regulations, outside of the ordinance, they can be spelled out with specific numerical values. Industry always wants to know the exact conditions of compliance.

Requirements For Industrial Waste Ordinances

The question of whether or not industrial wastes discharged to municipal sewage disposal systems should be controlled by a general sewer ordinance or a separate industrial waste ordinance is a matter of opinion. If an existing sewer ordinance does not fully cover industrial wastes, it might be more practical to develop a separate industrial waste ordinance. It would be well to review all existing regulations, such as building codes, plumbing codes, and health regulations. These can be incorporated in the industrial waste ordinance or its rules and regulations, or they can be noted by reference. Many of the rules for use of public sewers in Cincinnati's Industrial Waste Ordinance have been in the City Building Code for years.

The question of whether or not an ordinance controlling discharge of industrial wastes to a public sewage disposal system should be of the short or long form is also a matter of opinion. Reasons have already been stated for believing that a short form with separate rules and regulations has advantages over a long form. Reasons also have been given in favor of provisions, right in the ordinance, for collecting revenue.

References

1. "Water Pollution in the United States." U. S. Pub. Health Service Publ. No. 64, U. S. Govt. Printing Off., Washington, D.C. (1951).

2. "Municipal Sewer Ordinances." Manual of Practice No. 3, Federation of Sewage and Indus. Wastes Assns., Washington, D. C. (1949).

3. Comm. on Industrial Wastes, Calif. Sewage Works Assn., "A Report of Procedure for the Handling of Industrial Wastes." Sewage Works Jour., *18*, 3, 503 (May 1946).

4. "Report of the Ohio River Committee. Part I. Ohio River Pollution Control." U. S. Govt. Printing Off., Washington, D. C.

5. Joint Committees Report, "Fundamental Considerations in Rates and Rate Structures for Water and Sewage Works." Ohio State Law Jour., *12*, 151 (1951).

6. Schroepfer, G. J., "Determination of Fair Sewage Service Charges for Industrial Wastes." Sew. and Ind. Wastes, *23*, 1493 (1951).

ECONOMICAL SOLUTION to secondary settling need is provided by natural facilities at DuQuoin, Ill., sewage plant

Abandoned Strip Mine Cuts Used As Final Settling Units

Experiences at DuQuoin, Illinois, where need and economics dictated use of natural facilities

by **EUGENE JACOBY**
Superintendent
Sewage Treatment Works
DuQuoin, Illinois

THE ORIGINAL PLANS for the DuQuoin, Ill., sewage treatment plant, built in 1937, included a grit chamber and final settling tanks. These units were not constructed, however, because funds were not available at that time.

The existing plant, built immediately after a lawsuit with downstream property owners, consists of a manually cleaned bar screen, two rectangular primary settling tanks having a capacity of 1.2 mgd at 900 gpd per square foot overflow rate, two trickling filters 136 ft in diameter and containing about 6 acre-ft of rock media, a 30,000-cf digester equipped with heating coils and floating cover, and sludge drying beds having a total area of 10,000 sq ft. The large filter capacity indicates that the designing engineers made adequate allowance for packinghouse wastes which enter our sewer system. Fig. 1 shows the flow diagram for the plant.

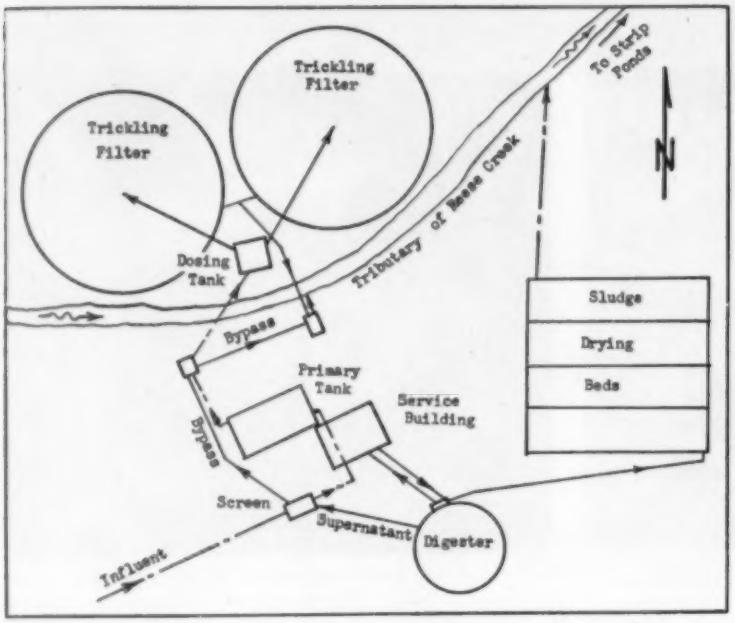
When the sewage treatment plant was initially put into operation in 1937 the effluent was satisfactory for discharge to the outlet stream, Reese Creek. However, as the load at the plant increased and the packing plant operations enlarged, the efficiency of the sewage treatment plant fell off and the need for final tanks became evident. This began to happen in January 1952.

As a result of some downstream complaints and the obviously poor quality of the effluent, a cooperative survey was arranged between the City of Du Quoin and the State Sanitary Water Board whereby flow measurements were made and samples for laboratory analyses were collected at the sewage treatment plant. The packing company provided information during the survey, since they were contributing a considerable amount of B.O.D. to the city sewer. Shortly before the survey was started the packing company installed additional facilities whereby grease and heavy solids could be removed and the remainder of their wastes could be pumped into the municipal sewer system. Previous to these new facilities some of the packing wastes entered Reese Creek without treatment.

The cooperative survey was made in September 1952. The results shown in Table 1 are typical of the composite sampling and flow data. Flow and strength varied considerably from hour to hour and even day to day, depending on the packinghouse operations.

Secondary Settling Needed

As a result of the survey it was concluded that the existing treatment



FLOW DIAGRAM of sewage treatment plant, not including secondary settling

units were not overloaded and that the poor quality of the effluent discharged to the creek indicated the need for final tanks. The cost of constructing final tanks was investigated, but it was found that the cost would involve a bond issue, which was very undesirable at that time. Therefore, other means of correcting the poor condition in Reese Creek were studied.

There is to the east of the plant a worked out strip mine area. Preliminary investigation showed that a water surface of approximately 2.5 acres could be utilized, with the water averaging 11 feet in depth. Arrangements were made with the packing company to cooperate on the stream clean-up project since they were very much interested in improving the water quality. The packing company was interested in purchasing the strip ponds because they were adjacent to their property and could be utilized as a source of irrigation water for their nearby pastures.

It was first believed that the trickling filter effluent would have to be pumped into the strip cut. However, it was later determined that gravity flow could be obtained with very little additional earth work. A permit was obtained from the State Sanitary Water Board to use the stripped area for final settling facilities with the thought that some oxidation and algae treatment could also be accomplished. The work of diverting the effluent ditch through the strip cut only took a few days with a dragline when it was finally begun. There was no practical method by which the water depth in the pond could be made shallower. Since the effluent ditch also receives surface drainage from approximately 300 acres during periods of runoff of rainfall, this is also carried through the strip pond.

Grab samples collected from the strip pond effluent since June 1954 have generally shown satisfactory B.O.D. results, as follows:

Date	B.O.D., ppm Tr. Filter	Pond Effl.
7/26/54	32	5.7
2/28/55	91	7.7
4/6/55	130	9.2

During December 1954 some difficulty was experienced with the pond during very cold weather. Fish began to die and the effluent darkened considerably. The dissolved oxygen was at or near zero. Before corrective measures could be taken the weather warmed up and a heavy rain provided enough oxygen to the pond contents to cause it to recover rather quickly.

During the entire spring, summer, and fall of 1955 the pond effluent was very good. During these warmer sunny periods the water is quite green with algae growths, although still satisfactory. Numerous fishes were noted in the pond from time to time.

During December 1955, when the temperature became abruptly cold, the pond again began to get dark and the dissolved oxygen on December 29, 1955 was zero. However, the B.O.D. of the pond effluent was 55 ppm., whereas that of the trickling filter was 110 ppm.

It was decided at that time to begin feeding of sodium nitrate in an attempt to correct the poor quality of the effluent. Such feeding was begun on January 4, 1956, by adding 300 pounds of industrial grade sodium nitrate directly to the ditch which carries the trickling filter effluent to the strip pond. The dosage was computed roughly to satisfy about 25 per cent of the total B.O.D. added to the pond. The nitrates were added by feeding 100 pounds three times daily, in the morning, about noon, and in the late afternoon.

By January 13 the pond had noticeably improved. The effluent from it had dissolved oxygen of 3.0 ppm and a B.O.D. of 35 ppm. The nitrate feed appeared to be very effective. Since the pond was improving and the cost of feeding nitrates was about $15 per day, it was discontinued on January 20. By January 25 the B.O.D. of the pond effluent was 15.5 ppm. Visual

TABLE 1

Survey Results, DuQuoin Sewage Treatment Plant
(September 1952)

Flow, gpd	Item	Sampling Point: Raw Sewage	Settled Sewage	Tr. Filter Effluent
325,000	pH	6.6	6.7	7.4
	Susp. sol., total (ppm)	150	80	170
	Susp. sol., vol. (ppm)	130	70	120
	B.O.D., 5-day (ppm)	940	980	150
435,000	pH	6.7	6.7	7.1
	Susp. sol., total (ppm)	430	100	110
	Susp. sol., vol. (ppm)	350	80	80
	B.O.D., 5-day (ppm)	610	410	74

improvement of the algae growths could be detected during the period of feeding nitrates.

Average results indicate that a B.O.D. of about 100 ppm is being added to the pond in flows of about 400,000 gpd, exclusive of storm water. This means about 332 pounds of B.O.D. added to the pond in 24 hours, or a loading of 133 pounds of B.O.D. per acre. This is about 4½ times the loadings normally recommended for conventional-type oxidation ponds treating settled sewage in Illinois.

During the extreme drought of the summer of 1954 the strip pond water was used for irrigation of pasture by the packing company.

Conclusions

Two years of experience with the use of the strip pond in lieu of final settling tanks has resulted in the following conclusions:

1. Deep ponds are subject to being affected by "turnover" during cold weather. The lower water strata in the ponds probably are septic continually, and when this water is raised by the sinking of heavier surface water in cold weather, the pond is upset and its dissolved oxygen content is depleted.

2. During periods of operation when temperatures remain above those which do not cause deep ponds to "turn over," operation of these ponds as final settling facilities is very satisfactory.

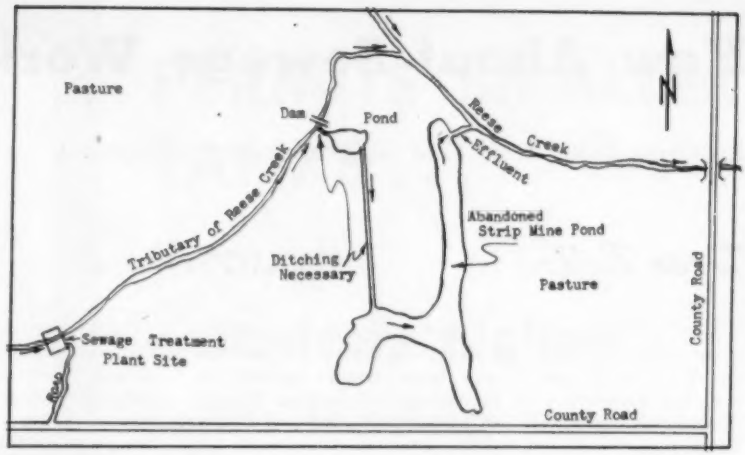
3. When the pond "turns over" and the contents become thoroughly mixed, dissolved oxygen can be maintained by feeding sodium nitrate proportioned so as to satisfy 25 per cent of the total B.O.D.

4. Our limited experience thus far does not indicate that continuous feeding of nitrates during cold weather will be necessary, and that only after the first "turnover" at the beginning of each cold weather season do the lagoon contents become deficient in dissolved oxygen without nitrate feeding.

5. Dissolved oxygen introduced into the strip pond by runoff of rainfall has been beneficial.

6. Prolific algae growths have not become a problem in the 11-ft depth of this strip pond.

7. Utilization of the pond has resulted in a substantial saving to the city by eliminating the need to construct final tanks. In addition, it is likely that had conventional final tanks been constructed, the final tank sludge volume would have required digester enlargements or other new facilities for handling the increased sludge load.



STRIP COAL mining ponds used as final settling tanks by construction of small diversion dam and simple ditching that utilizes natural ground slope to eliminate the necessity of pumping

"Ed" Trax, Veteran Filter Plant Sup't., is Dead at 74

Edward Carey Trax, city chemist and superintendent of water purification for McKeesport, Pa., for more than 48 years, died on February 26 after a short illness at his home. He was 74 years old.

"Ed" Trax was graduated as a B.S. in chemistry in 1906 by the University of Pittsburgh. His first position was as assistant chemist with the old Pittsburgh Water Company of Pittsburgh, Pa. In 1908 he was employed as City Chemist of McKeesport, Pa. This position he held for almost a half century up to his passing. Trax also was in charge of the McKeesport water filtration plant and conducted a consulting practice in water treatment for several municipalities and industrial plants in the Pittsburgh area.

Trax was a former director of the American Water Works Association, a past-chairman of the old Central State Section and the newer Pennsylvania Section of A.W.W.A. He was also a "wheel horse" and past-president of the Pennsylvania Water Works Operator's Association. In 1939 he was recipient of the George W. Fuller Award of the American Water Works Association, being cited for "distinguished service in the water works field."

"Ed" Trax was a real pioneer in water treatment in America.

A.W.W.A.—Illinois Section Elects New Officers

Officers elected for the coming year at the 46th Annual Meeting of the Illinois Section A.W.W.A., held 3-21-23, 1956, at the LaSalle Hotel, Chicago, were as follows:

Chairman: G. L. Davis, Plant Superintendent, Water Works, Decatur. Vice-Chairman: C. L. Baylor, Village Engineer, Downers Grove. Trustees: T. E. Larson, Head, Chemical Sub-Division, Illinois State Water Survey, Urbana; Armon Lund, Superintendent of Public Works, Wilmette; and W. W. Wolfe, American Cast Iron & Pipe Co., Chicago.

E. E. Alt, Chicago Bridge & Iron Co., Chicago, continues as Section Director, and D. W. Johnson, Cast Iron Pipe Research Ass'n., Chicago, was re-elected Secretary-Treasurer.

Paul M. Albert Establishes Consulting Office

Paul McHenry Albert announces the opening of engineering offices at 206 South Main St., Ann Arbor, Michigan.

For a number of years Mr. Albert was connected with the firm of Shoecraft, Drury & McNamee of Ann Arbor, Mich. To readers of WATER & SEWAGE WORKS he is best known for his nomographic charts for use in solving hydraulic problems, determining economical main sizes, etc. Several of these charts have appeared in the Reference & Data Editions of WATER & SEWAGE WORKS during past years. Others are to be published shortly.

How About Sewage Works Safety?

An Open Letter from One Superintendent to Another

Dear Bill:

I was glad to see the letter Jim wrote you last October about Safety in Water Works. I'm glad, too, to see that the American Water Works Association is catching up with the Federation of Sewage and Industrial Wastes Associations on this subject of safety. In case you hadn't realized it, the Federation has been safety minded for more than twelve years now.

Manual of Practice No. 1

You are undoubtedly familiar with the Manual of Practice Series, prepared under the direction of the Federation's Committee on Sewage Works Practice and published by FSIWA. You know what the first M.O.P. was?—Right!—"Occupational Hazards in the Operation of Sewage Works," often referred to as Van Kleeck's Manual, because LeRoy Van Kleeck of the Connecticut State Health Department headed the committee which wrote it. Manual of Practice No. 1 was authorized by the Federation Board of Control in October 1943 and published in 1944.

This has not been the only evidence of the Federation's interest in safety matters. I remember that at two Federation meetings a considerable amount of time was devoted to the showing and explanation of modern safety equipment and techniques.

In case you haven't a copy of the Federation's Manual of Practice No. 1, you should order it. Write to R. E. Fuhrman, Exec. Secy., FSIWA, 4435 Wisconsin Ave., N. W., Washington 16, D. C. In this book you will find a number of sections on specific subjects and practices, with an introduction which covers the nature of hazards in sewage works operation and data on accidents in sewage works. It is pointed out that the hazards in sewage treatment works can be offset by proper design of facilities, use of safety equipment, efficient administration, and the execution of safe practices.

Prevention of physical injuries is discussed in relation to design, safety equipment and safe practices for sewers, pumping stations, and treatment plants. Prevention of body infections is covered in relation to frequency of infection, plant design, safety equipment, and safe practices.

Gases, Vapors and Oxygen Deficiency

By far the greater portion of the manual is devoted to "The prevention of dangers from noxious gases, vapors and oxygen deficiency." General topics are presented first, including such items as where dangers lie, definitions of terms, and characteristics of dangerous gases which may be encountered in sewage works.

In this general section, too, information is presented on the occupational hazard of these gases in reference to design, safety equipment, and safe practices. Design features are included for sewers, pumping stations, treatment plants, sludge pumping facilities, sludge digestion tanks, sludge gas collection, and chlorine handling facilities.

One section is devoted to the description and use of equipment for detecting various gases. Another section covers the subject of respiratory protective apparatus, such as cannister gas masks, self-contained oxygen breathing apparatus, hose mask, etc. Also covered are portable lighting equipment, non-sparking tools, portable blowers, signs, inhalators, and safety belts.

In reference to safe practices and gas hazards the manual discusses fire and explosion prevention, sludge gas leak investigations, operation of sludge digestion tanks and gas holders, gas rescue technique, and handling of chlorine leaks.

Resuscitation techniques are given for the Schaeffer prone-pressure method of artificial respiration, not the more recent Nielsen method (see *Wat. & Sew. Wks.*, Vol. *102*, p. 169; 1954). However, a later revision of the manual contains a complete illustrated description of the Nielsen method in an Appendix.

The Manual concludes with a general summary and recommendations relative to the hazards from gases, fumes, and oxygen deficiency, and an appendix listing accidents that had occurred in sewage works through 1943.

Other Information

In addition to this manual, an excellent series of articles by LeRoy W. Van Kleeck appeared in *Water & Sewage Works*, under the title "Safety in Sewage Works Maintenance and Operation." The first of that series appeared in *W&SW* on page 283 of the July 1953 issue. The seventh and concluding article in the series appeared on page 84 of the February 1954 issue.

The "20-Year Index" to *Sewage Works Journal* lists 35 references, including 12 abstracts. One of these references covers the Safety Code of the New England Sewage and Industrial Wastes Association and the New York Sewage and Industrial Wastes Association adopted by these two organizations in 1940. Since 1948, *Sewage and Industrial Wastes* has carried 35 references, including a number of abstracts and editorials.

Without doubt it can truly be said that the Federation and its member associations have been thoroughly conversant with the subject of safety. And I think you'll agree with me that we must all continue to be alert to the matter of safety in sewage works.

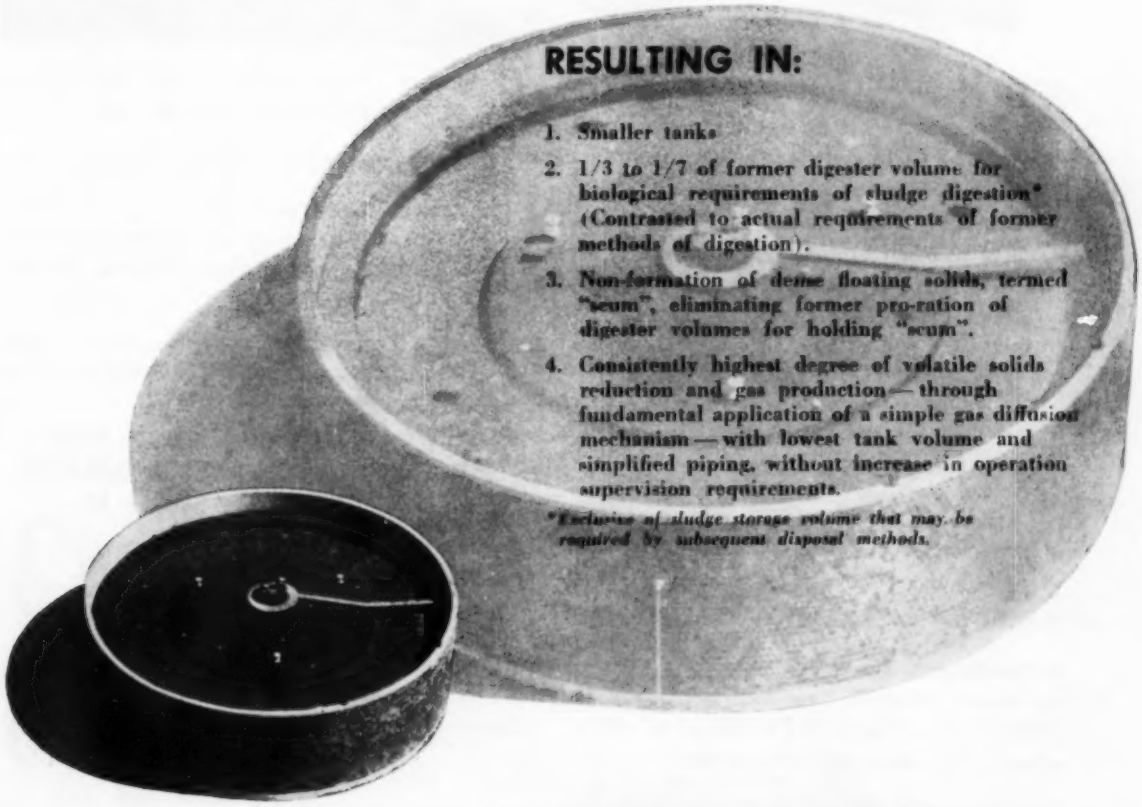
Yours, Jack

CRP*

CATALYTIC
REDUCTION
PROCESS

PERMITS SMALLER TANKS...

through exclusively highest solids loading for sludge digestion



RESULTING IN:

1. Smaller tanks
2. 1/3 to 1/7 of former digester volume for biological requirements of sludge digestion* (Contrasted to actual requirements of former methods of digestion).
3. Non-formation of dense floating solids, termed "scum", eliminating former pro-ration of digester volumes for holding "scum".
4. Consistently highest degree of volatile solids reduction and gas production — through fundamental application of a simple gas diffusion mechanism — with lowest tank volume and simplified piping, without increase in operation supervision requirements.

**Exclusive of sludge storage volume that may be required by subsequent disposal methods.*

Reports Available

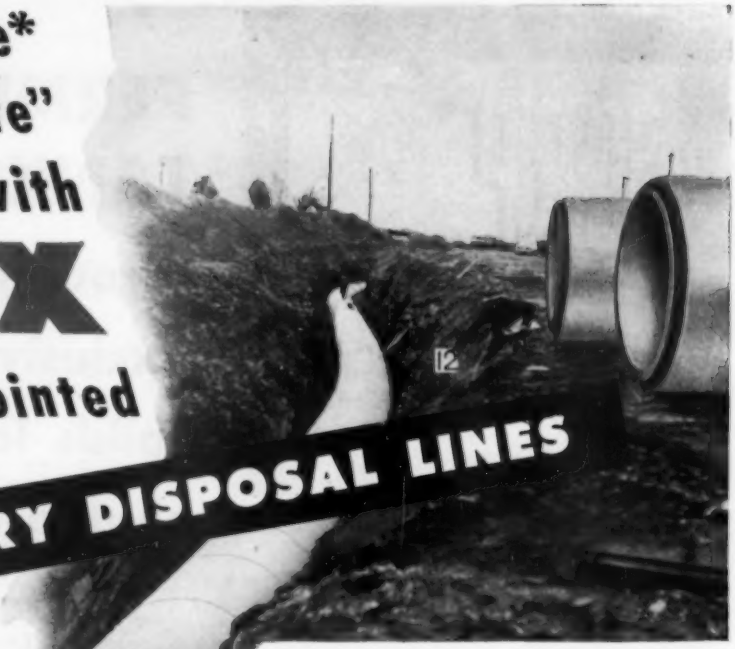
Reports describing the PROCESS in detail are available on request. Write to Department F.

** Patents Applied For*

CHICAGO PUMP COMPANY
Subsidiary of Food Machinery and Chemical Corporation
SEWAGE EQUIPMENT DIVISION
622 DIVERSEY PARKWAY • CHICAGO 14, ILLINOIS

Flush Kleen ®, Scru-Peller ®, Plunger, Horizontal and Vertical Non-Clogs Water Seal Pumping Units, Samplers . . Swing Diffusers, Stationary Diffusers, Mechanical Aerators, Combination Aerator-Clarifiers, Barminutor ®, Comminutors.

Louisville* "Plays Safe" with TYLOX Jointed SANITARY DISPOSAL LINES



*PROJECT—*Trunk sewers for METROPOLITAN SEWER DISTRICT, Louisville, Ky.*

ENGINEER—*Morris Forman, Chief Engineer*

PIPE—*Over 31,000 feet of 60" and 70" reinforced concrete pipe manufactured by Kentucky Concrete Pipe Company, Frankfort, Ky.*

CONTRACTORS—*Ruby Construction Company, Inc., and W. L. Hailey and Company, Inc., Louisville, Ky.*

When engineers and sanitary officials of the Louisville and Jefferson County Metropolitan Sewer District specified TYLOX RUBBER JOINTS for new trunk sewers, they "played safe" on three factors that mean a lot in protecting public funds invested in waste disposal projects. Their TYLOX decision automatically assured:—

No Infiltration — Passage of water **in or out** of the pipe joint is prevented by "compression-tight" Tylox Rubber Gaskets. Tylox Joints help reduce costs of sewage treatment.

No Joint Failures — The rubber of Tylox is specifically compounded to defeat sewerage and industrial waste corrosives. Under ground, and under compression, Tylox outlasts the pipe itself. Tylox helps reduce maintenance costs.

No Installation Delays — Flexible Tylox compensates for pipe angularities in any plane . . . permits wet-trench jointing and immediate backfilling. Tylox helps cut construction costs . . . keeps jobs ahead of schedule with **more pipe laid per day.**

TYLOX is the **one** Pipe Joint which fully meets requirements of engineers, sanitary officials and construction men alike.

MAKING JOINTS WITH TYLOX RUBBER GASKETS IS AS SIMPLE AS

A

Cement tongue and snap on TYLOX gasket.

B

Lubricate sliding surfaces with TYLOX cement.

C

Shove the pipe home to line and grade.

5000

Specify TYLOX RUBBER JOINTS and play safe on your next pipe job. Write for full information and more TYLOX case histories TODAY.

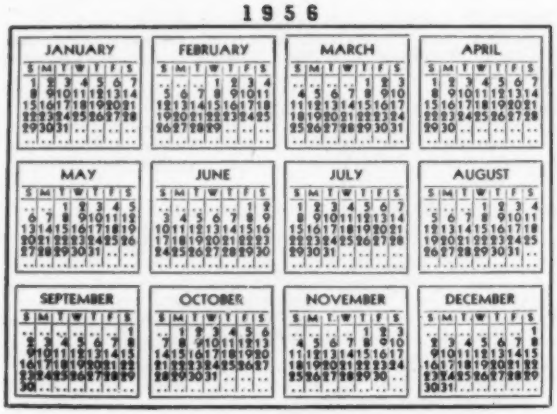
HAMILTON KENT MANUFACTURING COMPANY

427 West Grant St., Kent, Ohio ORchard 3-9555

W&SW

Meetings Scheduled

1956



Apr. 3-5—Philadelphia, Pa. *(Bellevue-Stratford Hotel)*
PENNSYLVANIA SECTION, A.W.W.A., Secy., L. S. Morgan, State Dept. of Health, Greensburg, Pa.

Apr. 3-6—Madison, Wis. *(University of Wisconsin)*
WISCONSIN WATER WORKS OPERATORS SHORT COURSE, Prof. Gerard A. Rohlich, Univ. of Wisconsin.

Apr. 4-6—Topeka, Kansas *(Jayhawk Hotel)*
KANSAS SECTION, A.W.W.A., Secy., Harry W. Badley, 119 W. Cloud, Salina, Kansas, and KANSAS SEWAGE & INDUSTRIAL WASTES ASSN., Robert H. Hess, Sec.-Treas., Dept. of Water Supply & Sewage Treatment, City Building, Wichita, Kansas.

Apr. 5-6—Chapel Hill, N. C. *(Carolina Inn)*
FIFTH SOUTHERN MUNICIPAL & IND. WASTE CONF., Daniel A. Okun, Univ. of North Carolina, Chapel Hill, N. C.

Apr. 5-7—Safford, Arizona *(Buena Vista Hotel)*
ARIZ. SECTION, A.W.W.A. AND ARIZ. SEWAGE & WATER WORKS ASSN., (Joint Meeting) Quentin Mees, Secy.-Treas., 721 N. Olsen Ave., Tucson, Ariz.

Apr. 6-7—Livingston, Montana *(Murray Hotel)*
MONTANA SECTION, A.W.W.A., Secy., A. W. Clarkson, State Board of Health, Helena, Montana.

Apr. 11—Rockland, Maine
MAINE WATER UTILITIES ASSOCIATION, Gerard F. Laurin, Secy.-Treas., 89 Western Avenue, Augusta, Maine.

Apr. 11-13—Lincoln, Nebraska *(Cornhusker Hotel)*
NEBRASKA SECTION, A.W.W.A., Secy., John E. Olsson, 922 Trust Bldg., Lincoln, Nebr.

Apr. 18-20—Utica, New York *(Hotel Utica)*
NEW YORK SECTION, A.W.W.A., Secy., Kimball Blanchard, 56 Grand St., White Plains, N. Y.

Apr. 19-20—Natural Bridge, Va. *(Natural Bridge Hotel)*
VIRGINIA IND. WASTES AND SEW. WORKS ASSN., J. L. Hamrick, Secy.-Treas., National Aniline Div., Allied Chemical & Dye Corp., Hopewell, Va.

Apr. 23-25—London, Ontario *(Hotel London)*
CANADIAN SECTION, A.W.W.A., Secy., A. E. Berry, 72 Grenville St., Toronto, Ont., Canada.

Apr. 25-28—Santa Rosa, Calif. *(Santa Rosa Hotel)*
CALIF. SEW. & IND. WASTES ASSN., J. C. Mallery, Sec.-Treas., 4822 N. Dunsmore Ave., LaCrescenta, Calif.

Apr. 26-28—Victoria, B. C. *(Canada Empress Hotel)*
PACIFIC NORTHWEST SECTION, A.W.W.A., Secy., Fred D. Jones, Distr. Supervisor, Rm. 305, City Hall, Spokane, Wash.

(Continued on page 78A)

Announcing... the new, exclusive

GRINNELL-SAUNDERS STRAIGHTWAY DIAPHRAGM VALVE

The diaphragm valve with STRAIGHT-THROUGH FLOW, for handling viscous materials, fibrous slurries, sludges, pulp stock, latex, magmas, semi-fluid foods, solids in suspension, sewage, water, corrosive chemicals

OPEN
Diaphragm lifts high for streamline flow in either direction. No pockets to trap sludge

CLOSED
Diaphragm presses tight for positive closure even when handling gritty or fibrous materials

The Grinnell-Saunders STRAIGHTWAY Diaphragm Valve* offers these exclusive features: the ability to handle viscous materials without restriction or stoppage; minimum pressure drop; rodding or brushing without need of removing bonnet and without possibility of damaging body linings; self-draining when line is pitched sufficiently to drain piping.

Grinnell-Saunders STRAIGHTWAY Diaphragm Valves come in a range of body, lining and diaphragm materials. Inquiries invited. Bulletin on request.

*Patented

GRINNELL COMPANY, INC.
230 West Exchange St., Providence, R. I.

Kindly send me a complimentary copy of your "Grinnell-Saunders Straightway Diaphragm Valve" bulletin.

Name _____

Title or Function _____

Company _____

Address _____

City _____ State _____

Plastic Coating Stops Costly Condensation Drip and Rust

THE COSTLY PROBLEM caused by dripping from this sweating pipe was permanently solved with one easy and inexpensive application of NoDrip Plastic Coating. Sweating pipes, ceilings, air ducts and other metal equipment are also completely protected against rust and corrosion by low cost NoDrip.

NoDrip Plastic Coating acts immediately to insulate and protect. One application adds many years of service life to metal equipment. NoDrip is also resistant to acid, alkali and brine...protects concrete, brick, plaster, tile wood or composition surfaces.

Easy application requires no special equipment or skill. Anyone can apply NoDrip with brush, trowel or spray. Stop your condensation problem now! Get full details without delay.

JW Mortell COMPANY

FREE

32-PAGE NoDrip DATA HANDBOOK

Complete with photographs, charts and technical information to solve your condensation problem. Write today.

Available at leading plumbing and mill supply houses

J. W. MORTELL CO., 599-D Burch St., Kankakee, Ill.

Please send my FREE copy of the NoDrip Data Handbook.

Name_____

Company_____ Title_____

City_____ Zone____ State_____

May 6-11—St. Louis, Mo. *(Diamond Jubilee Conference)*
AMERICAN WATER WORKS ASSN., Secy., Harry E. Jordan, 2 Park Ave., New York, N. Y.

May 10-11—Washington, D. C. *(Willard Hotel)*
MARYLAND-DELAWARE WATER & SEWERAGE ASSN., W. M. Bingley, Secy.-Treas., 2411 N. Charles St., Baltimore 18, Md.

May 14-16—St. Joseph, Michigan *(Whitcomb Hotel)*
MICHIGAN SEWAGE & INDUSTRIAL WASTES ASSN., Donald M. Pierce, Secy.-Treas., Dept. of Health, Administration Bldg., Lansing 4, Michigan.

May 15-17—Lafayette, Indiana *(Purdue Memorial Union)*
PURDUE 11TH INDUSTRIAL WASTE CONFERENCE, Chairman, Don E. Bloodgood, C.E. Bldg., Purdue University, Lafayette, Indiana.

May 17-19—New York, New York *(Statler Hotel)*
THE NEW YORK STATE SOCIETY OF PROFESSIONAL ENGINEERS, George Baer, Chairman, N. Y. State Society of Professional Engineers, Inc., 1941 Grand Central Terminal, New York 17, N. Y.

May 28-29—Buffalo, New York *(Hotel Statler)*
NEW YORK SEWAGE & INDUSTRIAL WASTES ASSN., R. C. Sweeney, Exec. Secy., State Dept. of Health, 21 North Broadway, White Plains, N. Y.

June 4-6—Auburn, Alabama *(Ala. Polytechnic Institute)*
ALABAMA WATER & SEWAGE ASSN., W. L. Samuel, Secy., Byrd L. Moore & Co., Box 143, Fairhope, Ala.

June 4-8—Knoxville, Tenn. *(University of Tennessee)*
AMERICAN SOCIETY CIVIL ENGINEERS, Exec. Secy., W. H. Wisely, 33 West 39th St., New York 18, N. Y.

June 5—New Milford, N. J. *(Hackensack Water Company)*
NEW JERSEY SECTION, A.W.W.A., Plant Inspection and Spring Outing. Secy., C. B. Tygert, Box 178, Newark, N. J.

June 7—Storrs, Connecticut *(University of Conn.)*
NEW ENGLAND SEWAGE & INDUSTRIAL WASTES ASSN., Henry F. Munroe, Secy.-Treas., 75 Paine Ave., Cranston 10, R. I.

June 13—Boothbay Harbor, Maine
MAINE WATER UTILITIES ASSOCIATION, Gerard F. Laurin, Secy.-Treas., 89 Western Avenue, Augusta, Maine.

June 13-15—Cleveland, Ohio *(Carter Hotel)*
OHIO SEWAGE & INDUSTRIAL WASTES TREATMENT CONFERENCE (30th Annual Meeting) Ward E. Conrad, Secy.-Treas., 301 Ohio Depts. Building, Columbus 15, Ohio.

June 17-22—Atlantic City, N. J. *(Chalfonte Haddon Hall)*
AMER. SOC. FOR TESTING MATERIALS, Asst. Secy., Fred F. Van Atta, 1916 Race St., Philadelphia, Pa.

June 18-22—Meriden, N. H. *(Kimball Union Academy)*
GORDON RESEARCH CONFERENCE ON STREAM SANITATION, W. George Parks, Director, Department of Chemistry, University of Rhode Island, Kingston, R. I.

June 20-22—Green Bay, Wisconsin *(Northland Hotel)*
CENTRAL STATES SEWAGE & INDUSTRIAL WASTES ASSN., Geo. F. Bernauer, Secy.-Treas., 713 Chapman Street, Madison, Wis.

Aug. 8—Kennebunk, Maine
MAINE WATER UTILITIES ASSOCIATION, Gerard F. Laurin, Secy.-Treas., 89 Western Avenue, Augusta, Maine.

Aug. 27-29—University Park, Pa. *(Pennsylvania State Univ.)*
PENNA. WATER WORKS OPERATOR'S ASSN., Secy., R. Rupert Kountz, Dept. San. Eng., Penna. State Univ., University Park, Pa.

August 29-31—University Park, Pa. *(Pennsylvania State Univ.)*
PENNSYLVANIA SEWAGE & INDUSTRIAL WASTES ASSN., Secy., J. R. Harvey, 916 Diamond, Meadville, Pa.

Sept. 5-7—Clear Lake, Iowa *(P. M. Park)*
IOWA SEWAGE & INDUSTRIAL WASTES ASSN., L. F. Skorczeski, Secy.-Treas., 207 South 15th Avenue, Marshalltown, Iowa.

Sept. 9-12—Pittsburgh, Pa. *(Wm. Penn Hotel)*
AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, F. J. Van Antwerpen, 25 West 45th St., New York 36, N. Y.

Sept. 12-14—Bolton Landing, Lake George, N. Y. *(Sagamore Inn)*
NEW YORK SECTION, A.W.W.A., Secy., Kimball Blanchard, 56 Grand St., White Plains, N. Y.

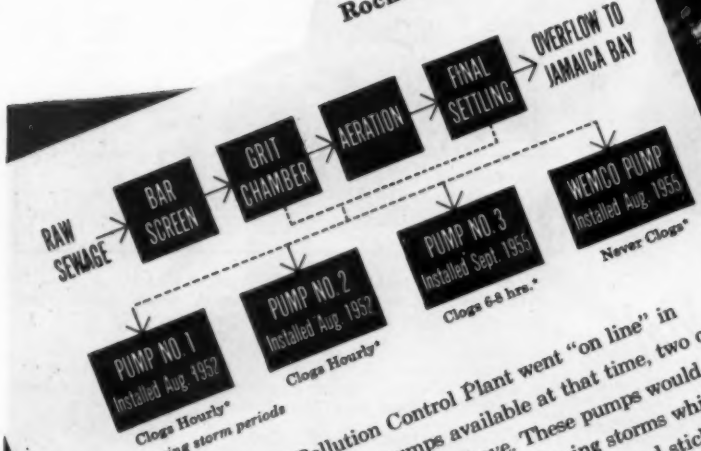
(Continued on page 80A)

WEMCO *the sewage pump that never clogs* **PROVED IN COMPETITIVE SERVICE** *at Rockaway, New York*

Rockaway New York Pollution Control Plant

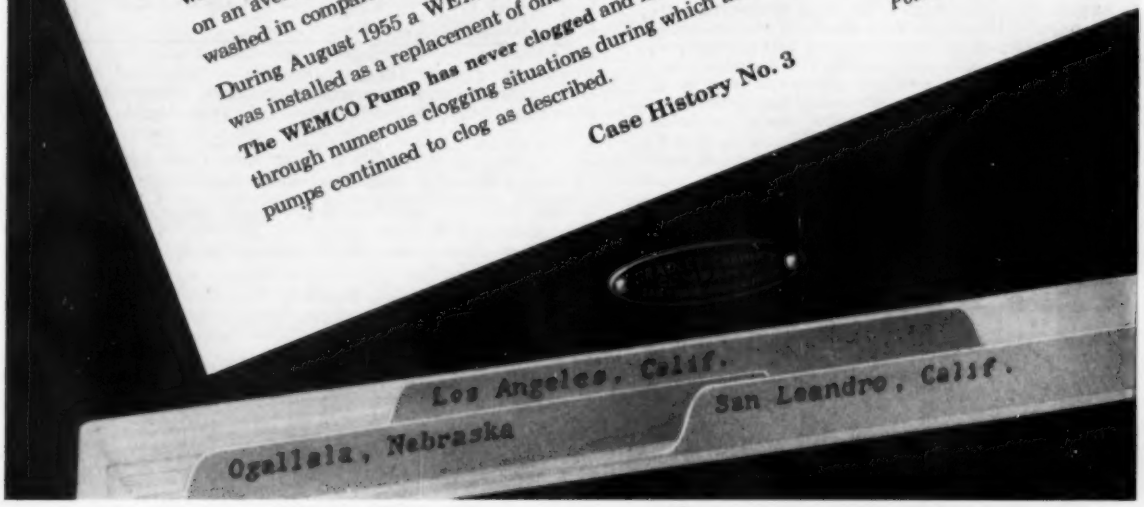
Wemco Pump Installation at the Rockaway Plant

Rockaway New York Pollution Control Plant



The Rockaway Pollution Control Plant went "on line" in August 1952 using four pumps available at that time, two of which remain in the flow sheet above. These pumps would plug on an average of once every two hours during storms which washed in comparatively large amounts of rags and sticks. During August 1955 a WEMCO Torque Flow Solids Pump was installed as a replacement of one of the four original pumps. **The WEMCO Pump has never clogged** and has operated through numerous clogging situations during which the other pumps continued to clog as described.

Case History No. 3



Wemco's unique torque-flow design has been responsible for many outstanding "never clog" records. The principle is fully explained in available literature. It will save you thousands of dollars in operating costs. Write today for your copy.

WEMCO
WESTERN MACHINERY COMPANY

762-L Folsom St. • San Francisco 7, Calif. • Representatives in principal cities of the United States and Canada and in major countries throughout the world

Free to motor users

New 16-page booklet

PACKED WITH FACTS ABOUT

VARIABLE SPEEDS

Here's a booklet that presents startling facts about variable speeds. It tells how to apply U. S. Varidrive motors to your equipment, ways to get more productive manhours, methods of improving quality of workmanship, more efficient plant operations, and lists savings you can make in power and payroll. This valuable engineering booklet is profusely illustrated in striking colors. It details latest improvements and shows how you can have speeds from 2 to 10,000 rpm at your command. Illustrates 28 Varidrive models. ¼ to 50 h.p. Request this amazing 16-page booklet for latest data on variable speeds.

U.S. VARIDRIVE

—The miracle motor

U. S. ELECTRICAL MOTORS Inc.

Los Angeles 54, Calif. Milford, Conn.

REQUEST FOR VARIDRIVE BOOKLET

U. S. ELECTRICAL MOTORS INC. W&S-4
Box 2058, Los Angeles 54, Calif., or Milford, Conn.

NAME_____

COMPANY_____

ADDRESS_____

CITY_____ ZONE____ STATE_____

Sept. 12-14—Flint, Michigan *(Durant Hotel)*
MICHIGAN SECTION, A.W.W.A., Secy., T. L. Vander Velde, Mich. Dept. of Health, Lansing 4, Mich.

Sept. 12-14—St. Paul, Minn. *(Lowry Hotel)*
NORTH CENTRAL SECTION A.W.W.A., Secy., Leonard N. Thompson, Gen. Manager, Water Dept., St. Paul 2, Minn.

Sept. 16-19—Bretton Woods, N. H. *(Mt. Washington Hotel)*
NEW ENGLAND WATER WORKS ASSN., Secy., Joseph C. Knox, N.E.W.W.A., 73 Tremont St., Boston 8, Mass.

Sept. 17-19—Chattanooga, Tenn. *(Hotel Patten)*
KENTUCKY-TENN. SECTION, A.W.W.A., Secy., J. Wiley Finney, Jr., Howard K. Bell Engrs., 533 S. Limestone St., Lexington, Ky., and KENTUCKY-TENN. INDUSTRIAL WASTES & SEWAGE WORKS ASSN., S. Leary Jones, Secy.-Treas., Cordell Hull Building, Nashville, Tenn.

Sept. 19-21—Atlanta, Georgia *(Georgia Tech.)*
GEORGIA WATER & SEWAGE ASSN., 25th Annual Georgia Water & Sewage School, Georgia Institute of Technology, A. T. Storey, Secy.-Treas., 1210 Hemphill Ave., N.W., Atlanta, Ga.

Sept. 19-21—Toledo, Ohio *(Commodore Perry Hotel)*
OHIO SECTION, A.W.W.A., Secy., M. E. Druley, Dist. Mgr., Dayton Power & Light Co., Wilmington, Ohio.

Sept. 23-26—Fort Worth, Texas *(Texas Hotel)*
AMERICAN PUBLIC WORKS ASSN. (Public Works Congress), Robert D. Bugher, Asst. Director, 1313 E. 60th St., Chicago 37, Ill.

Sept. 26-28—LaCrosse, Wisconsin *(Stoddard Hotel)*
WISCONSIN SECTION, A.W.W.A., Leon A. Smith, Supt. Water and Sewage, City Hall, Madison 3, Wisconsin.

Sept. 30-Oct. 1, 2—Jefferson City, Missouri *(Hotel Governor)*
MISSOURI SECTION, A.W.W.A., and MISSOURI WATER & SEWERAGE CONFERENCE, Warren A. Kramer, Secy.-Treas., Division of Health, Jefferson City, Missouri.

Oct. 4-6—Boise, Idaho *(Hotel Boise)*
PACIFIC NORTHWEST SEWAGE & INDUSTRIAL WASTES ASSN., W. W. Saxton, Secy.-Treas., 408 Old Capitol Bldg., Olympia, Wash.

Oct. 8-11—Los Angeles, Calif. *(Hotel Statler)*
FEDERATION OF SEWAGE AND INDUSTRIAL WASTES ASSNS., Ralph E. Fuhrman, Exec. Secy., 4435 Wisconsin Ave., N.W., Washington 16, D. C.

Oct. 10—Caribou, Maine
MAINE WATER UTILITIES ASSOCIATION, Gerard F. Laurin, Secy.-Treas., 89 Western Avenue, Augusta, Maine.

Oct. 14-17—Little Rock, Arkansas *(Marion Hotel)*
SOUTHWEST SECTION, A.W.W.A., Secy., Leslie A. Jackson, Robinson Memorial Auditorium, Little Rock, Ark.

Oct. 15-16—St. John, New Brunswick *(Admiral Beatty Hotel)*
MARITIME BRANCH, CANADIAN SECTION, A.W.W.A., J. D. Kline, Secy.-Treas., Public Service Comm., P. O. Box 608, Halifax, N. S.

Oct. 15-19—Pittsburgh, Pa. *(Wm. Penn Hotel)*
AMERICAN SOCIETY OF CIVIL ENGINEERS, Exec. Secy., W. H. Wisely, 33 W. 39th St., New York 18, N. Y.

Oct. 18-20—Atlantic City, N. J. *(Hotel Madison)*
NEW JERSEY SECTION, A.W.W.A., Secy., C. B. Tygert, Box 178, Newark 1, N. J.

Oct. 21-24—Mobile, Alabama *(Battlehouse Hotel)*
ALABAMA-MISSISSIPPI SECTION, A.W.W.A., Secy., Charles W. White, State Dept. Public Health, 537 Dexter Ave., Montgomery, Ala.

Oct. 22-26—San Diego, Calif. *(U. S. Grant Hotel)*
CALIFORNIA SECTION, A.W.W.A., Secy., H. J. Ongerth, Engr., State Dept. Health, 2180 Milvia St., Berkeley, Calif.

Oct. 24-26—Des Moines, Iowa *(Hotel Fort Des Moines)*
IOWA SECTION, A.W.W.A., Secy., J. J. Hail, Supt. of Water, City Hall, Dubuque, Ia.

(Continued on page 82A)

Why settle for less?

With Pennsalt liquid chlorine you avoid impurities which cause equipment trouble

You needn't accept less than the highest-purity chlorine in trouble-free cylinders. At no extra cost, you can have Pennsalt Chlorine, which is taken through an extra fractionating column and bottled *by the manufacturer*. Pennsalt has provided thirty years' uninterrupted cylinder service to chlorine users, even through wars and cyclical chlorine shortages.

To assure you maximum purity and safety, Pennsalt puts all chlorine cylinders through rigid inspection and reconditioning on each trip back home: Valves are dismantled, remachined if not up to Pennsalt standards, repacked, and then tested for leaks at 500 psi. After refilling, cylinders are given two final tests for leaks and workability at intervals of 24 hours or more.

Call your nearby Pennsalt district office for a technical bulletin on Pennsalt Liquid Chlorine, or write Industrial Chemicals Division 306, Pennsylvania Salt Manufacturing Company, Three Penn Center Plaza, Philadelphia 2, Pa.

Other Pennsalt Chemicals for water and sewage treatment:

Anhydrous Ferric Chloride, Liquid Ferric Chloride, Alum, Per*chloron*® (high-test calcium hypochlorite).

Chemical Progress Week, April 23-28

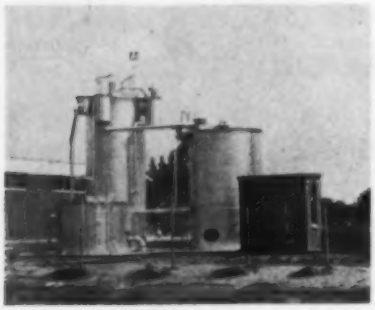
Pennsalt Chemicals

PENNSALT DISTRICT OFFICES

Appleton, Wisconsin
Chicago 1, Illinois
Cincinnati 2, Ohio
Cleveland 2, Ohio
Decatur, Georgia
Detroit 26, Michigan
Paterson 1, New Jersey
Philadelphia 2, Pennsylvania
Pittsburgh 19, Pennsylvania
St. Louis 1, Missouri
Tacoma 2, Washington

Exacting care, from the moment of manufacture until delivery, assures you not only the high purity you expect of Pennsalt Chlorine but also freedom from vexing and hazardous mechanical difficulties.

AN ALL STEEL
Waste Treatment Plant



The tank at the left is a Spiragester, the tank to the right is a high rate filter, and the short tank in the foreground is a non-mechanized hoppered bottom final Spiraflo Clarifier. The plant handles the wastes from an ice cream manufacturing plant.

Write for New
Spiragester Bulletin No. 135

LAKESIDE ENGINEERING CORPORATION
222 West Adams Street • Chicago 6, Ill.

MERIT PROVEN *in* MANY INDUSTRIES

Aurora Non-Clog Pumps are available in both vertical and horizontal types—and are widely used in industry for handling liquid products, particularly heavy liquids and liquids containing solids. Also used for industrial by-products, semi-solids, wastes, municipal sewage etc. For impressive specifications and design features ask for **BULLETIN 121-C.**

Type Ku Aurora Vertical Non-Clog Pump. Sizes to 10"

DISTRIBUTORS IN PRINCIPAL CITIES

AURORA® PUMP DIVISION
THE NEW YORK AIR BRAKE COMPANY
68 LOUCKS STREET • AURORA • ILLINOIS

Oct. *24-26*—Baltimore, Maryland *(Southern Hotel)*
CHESAPEAKE SECTION, A.W.W.A., Secy., Carl J. Lauter, 6955 33rd Street, Washington 15, D. C.

Oct. *29*-31—Windsor, Ontario *(Prince Edward Hotel)*
THE CANADIAN INSTITUTE ON SEWAGE & SANITATION, A. E. Berry, Sec.-Treas., Ontario Dept. of Health, Parliament Bldg., Toronto, Ontario, Canada.

Oct. 31-Nov. 1-*2*—Bluefield, W. V. *(West Virginia Hotel)*
WEST VIRGINIA SECTION, A.W.W.A., Secy., Hugh W. Hetzer, Engr., W. Va., Water Service Co., Charleston, W. Va., and WEST VIRGINIA SEWAGE & INDUSTRIAL WASTES ASSN., G. O. Fortney, Secy.-Treas., State Health Dept., Charleston 5, W. Va.

Nov. 1-*2*—Omaha, Nebraska *(Castle Hotel)*
NEBRASKA SEWAGE & INDUSTRIAL WASTES ASSN., V. J. Lechtenberg, Secy.-Treas., 614 Standard Oil Bldg., Omaha, Neb.

Nov. 7-9—Old Point Comfort, Virginia *(Chamberlin Hotel)*
VIRGINIA SECTION, A.W.W.A., Secy., J. P. Kavanagh, 213 Carlton Terrace Bldg., Roanoke, Va.

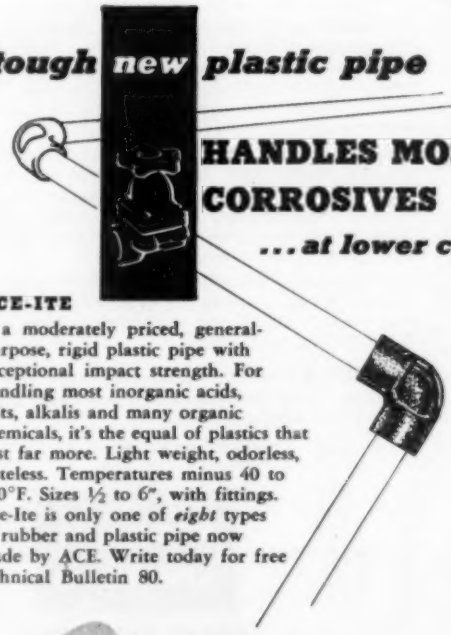
Nov. 12-14—Charlotte, N. C. *(Hotel Charlotte)*
NORTH CAROLINA SECTION, A.W.W.A., and NORTH CAROLINA SEWAGE & INDUSTRIAL WASTES ASSN., W. E. Long, Jr., Secy.-Treas., Box 2091, Raleigh, N. C.

Nov. 12-16—Atlantic City, N. J. *(Convention Hall)*
AMERICAN PUBLIC HEALTH ASSN., Secy., Dr. Reginald M. Atwater, 1790 Broadway, New York, N. Y.

Nov. *26-28*—Colorado Springs, Colo. *(Broadmoor Hotel)*
ROCKY MOUNTAIN SECTION, A.W.W.A., Jack W. Davis, Secy., Johns-Manville Sales Inc., Denver, Colorado.

Dec. *12*—Pittsfield, Maine
MAINE WATER UTILITIES ASSOCIATION, Gerard F. Laurin, Secy.-Treas., 89 Western Avenue, Augusta, Maine.

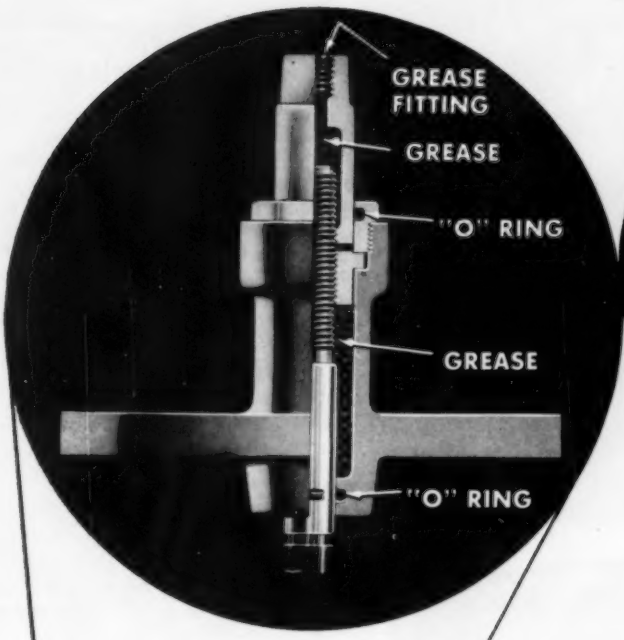
tough new plastic pipe



HANDLES MOST CORROSIVES
...at lower cost

ACE-ITE
is a moderately priced, general-purpose, rigid plastic pipe with exceptional impact strength. For handling most inorganic acids, salts, alkalis and many organic chemicals, it's the equal of plastics that cost far more. Light weight, odorless, tasteless. Temperatures minus 40 to 170°F. Sizes ½ to 6", with fittings. Ace-Ite is only one of *eight* types of rubber and plastic pipe now made by ACE. Write today for free technical Bulletin 80.

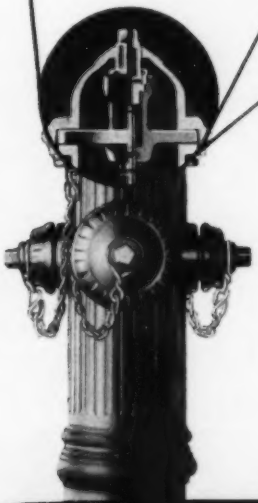
ACE rubber and plastic
processing equipment • SINCE 1852
AMERICAN HARD RUBBER COMPANY, 93 Worth St., New York 13, N. Y.



NEW DOUBLE FEATURE

SMITH[48] HYDRANTS

WITH "O" RING-SEAL AND GREASE CHAMBER FOR OPERATING THREADS



When you specify "O" Ring Seals rather than conventional packing you reduce maintenance to a minimum. The lower "O" Ring is the pressure seal, the upper "O" Ring the dirt seal. The initial compression of the "O" Rings provides the seal when the hydrant is closed. When subject to water pressure the lower "O" Ring is forced to the top of the groove. The sealing force increases as the pressure increases. The specially compounded rubber plastic "O" Rings insure a long life pressure seal. Each time the hydrant is operated, the "O" Ring Seals, the bearing surfaces, and the operating threads are automatically lubricated. Threads and upper section of the stem are continuously lubricated and sealed from contact with water in the standpipe. The lubricant is suitable for temperatures of minus 30 degrees to 200 degrees. All Smith Hydrants including hydrants in service can be fitted with "O" Ring Seal Plates.

FIRE HYDRANTS · VALVES · SINCE 1896

THE A.P. SMITH MFG. CO.

EAST ORANGE . NEW JERSEY

W & SW

Spillway

OVERFLOW FROM THE MAIN SECTION

Fresh Water at Sea

Britain's Royal Naval Scientific Service has developed a way of saving about $1,500,000 a year in distilling fresh water from sea water on ships.

The secret of this success is a chemical compound which is said to prevent scaling and the formation of foam, prolong the operating life of an evaporator five times, and increase its efficiency by about 30 per cent.

Fresh water can be made from sea water on board ship at a cost of around $1.68 a ton, as against the former cost of $2.52. Assuming a total annual production of distilled water throughout the British fleet of 2,000,000 tons the former cost would be nearly $5,000,000, the cost with the new treatment about $3,500,000.

The active ingredient in the new compound is one of the polyethylene glycols. It is said to be effective in quantities as low as 5 ppm of the sea water feed.

PRELOAD experience

for ALL your tanks

PRELOAD'S years of experience, plus its new policy of centralized engineering and licensing of qualified local contractors, covers the whole range of successful tank construction.

The clarifier tank (above) is but one of many types of prestressed concrete construction offered by PRELOAD. Over 1,000 tanks built are included in our record.

HOW YOU BENEFIT

- Greater efficiency and economy—greater reliability—are due to our licensees' special knowledge of local labor and materials resources. Most of them employ former Preload superintendents.
- Maintenance-free structures.
- Aesthetic virtues (possibilities of architectural treatment) unmatched in any other materials.
- A constant program of improvement in design and construction methods, available to all licensees.

PRELOAD through its own sales engineers or through its licensees is available for consultation. Technical data and literature available on request.

PRELOAD TRADE MARK

The Preload Company, Inc.
211 EAST 37th STREET
NEW YORK 16, N. Y.

The MF Method and the Needs of Working Sanitary Engineers

(A Letter to the Editor)

Having read the article on the "Advantages and Disadvantages of the Membrane Filter" by Rawn and Bowerman and the editorial on "The MF Technique" in our January 1956 issue, Professor Charles Renn of the Department of Sanitary Engineering, Johns Hopkins University, in a letter to the editor offers the following comments. They derive from experience with the MF method during four years. The several advantages of the method, as cited by Dr. Renn, are added to those given by Rawn and Bowerman, and Eliassen, and the January editorial comment.

The following are excerpts from Professor Renn's letter:

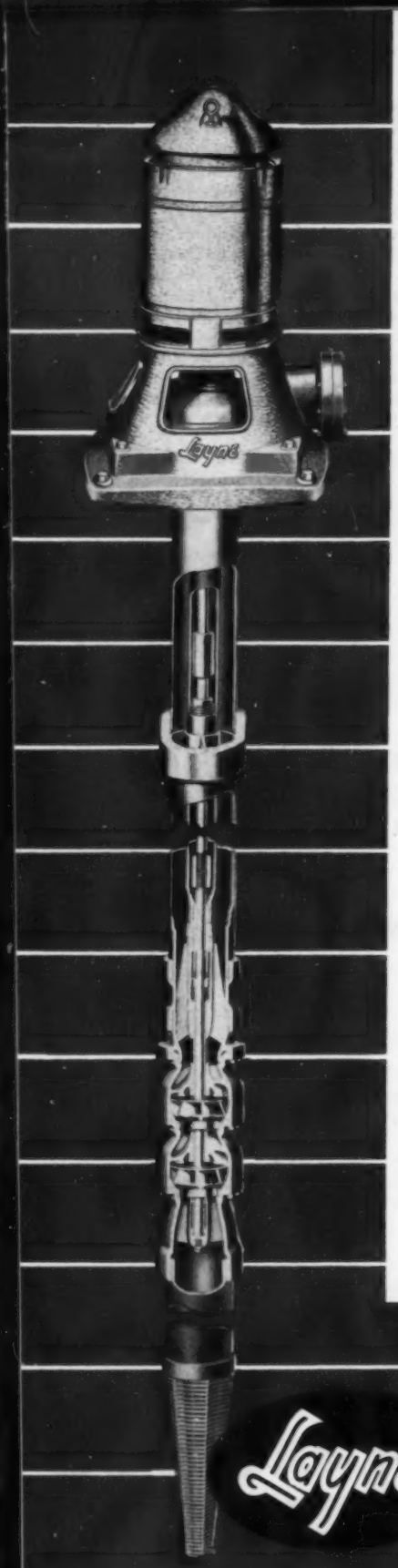
"The MF technique is far easier to teach engineers and others, than are the older methods. We can give men reasonable confidence in their work in two afternoons experience with the MF. Men still bungle pipettes and plugs when they leave us after experience with the standard (MPN) method.

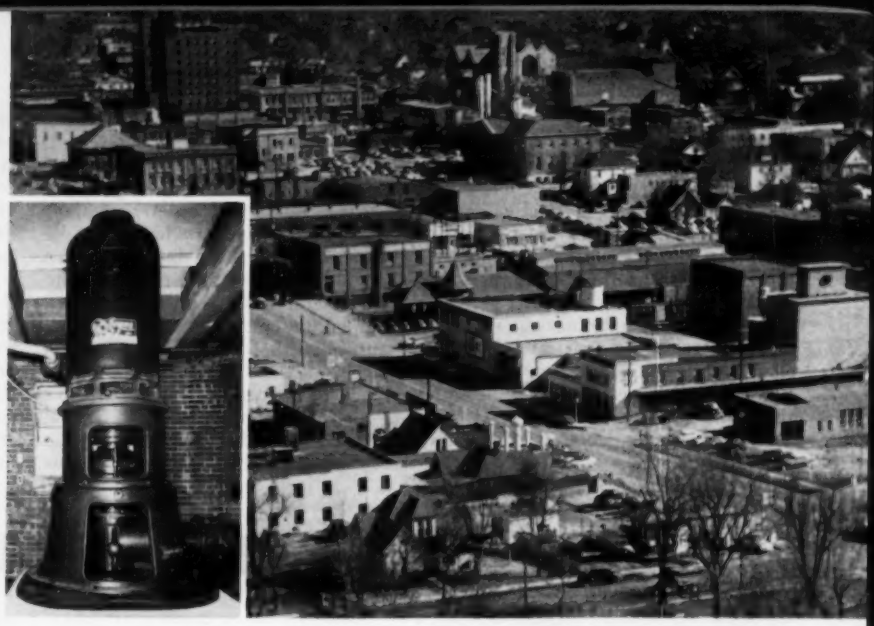
"The MF technique (with the Renn-Chesney Sabro Portable Laboratory Incubator combination) permits 20-hour field testing of water supplies and immediate reporting of results. Our usual methods of collection, transport, laboratory analyses and reporting—with a week to ten days' delay—is at best a bad piece of public relations, mostly pointless, and possibly catastrophic.

"MF cultures, by mounting, may be developed into a permanent visual record of performance, water quality variations, etc. The effects are always more satisfactory than numerical data.

"Modified MF techniques make it possible to isolate and demonstrate Shigella, Salmonella, and (frequently) Eberthella in polluted waters. The

(Continued on page 86A)





Higher Education Needs Water, Too!

Culture is the chief product of this picturesque city. Three major centers of higher learning—the University of Missouri, internationally famous Stephens College and Christian College—graduate hundreds of young Americans yearly.

With a population of approximately 40,000, Columbia has a modern water system that uses five Layne vertical turbine pumps with a daily capacity in excess of 6 million gallons.

Hundreds of American municipalities, ranging in size from the great metropolis to the smallest village, have found the wisdom of relying on Layne for any phase of water supply. Layne's complete service, including modernization, maintenance, exploration, drilling and pumping equipment, means that a project can be entrusted to Layne without a divided responsibility.

LAYNE
& BOWLER, INC.
MEMPHIS
General Offices and Factory

LAYNE ASSOCIATE COMPANIES THROUGHOUT THE WORLD

Layne

Water Wells • Vertical Turbine Pumps • Water Treatment

large samples that can be examined by MF allow one to pick up the less numerous organisms. I feel that work in this direction should be stimulated —we need much more direct evidence of the health hazard in rural-type supplies. The sanitary engineer commonly has to pull a technical bluff when he gets to the rural supply.

"Molecular membranes do not require 'strategic materials' such as agar-agar for completion steps. We must not forget the mess involved with agar substitutes during World War II."

In the foregoing comments Professor Renn emphasizes that the most practical consideration is the fact that the MF method is far better adapted to the needs of working sanitary engineers than anything heretofore offered.

He closes with the comment that the apparent indifference shown by the profession to the MF method indicates that the more influential elements are far removed from practical field problems.

Philadelphia Quartz Co. — 125 Years Old

It is not every year, or even every decade, that this magazine can salute one of its advertisers on its 125th birthday, an event being celebrated this year by the Philadelphia Quartz Company.

In observing their 125 years of continuous business the company has published a brochure the title and theme of which is "Respected Friend." This booklet tells the story of the company from its beginning in 1831 when the founder, Joseph Elkinton, opened a soap and candle factory at 377 South Second St., Philadelphia. Joseph Elkinton had been trained as a silversmith, but the manufacture of soap and candles appealed to him as a more suitable profession for a serious-minded Quaker.

The business grew steadily and in 1855 Joseph Elkinton took his two sons, Joseph S. and Thomas, into the firm. Young Thomas showed particular enthusiasm for the technical aspects of the business. He was intrigued by an article in a scientific publication describing silicates of soda and in 1858 he set about experimenting with this unusual and promising chemical. By mixing silicate of soda in the soap he learned that there was a decided improvement in washing action. Until the Civil War the sale of silicate to other soapmakers was negligible. At that time southern rosin was not available to northern soapmakers and silicate was substituted. The improved detergency of silicated soap was enthusiastically received by customers; other soapmakers became interested. Today, silicate is universally recognized as an important basic ingredient in soaps and synthetic detergents.

As the kerosene lamp began to take its toll of the candle business more time and effort was devoted to silicate of soda and applications for its use. Soapmaking continued at the original plant, but it became necessary to expand production for the manufacture of silicate. A larger factory was built in 1864 at 9th and Mifflin Streets, Philadelphia, and it was then that the name of Philadelphia Quartz Co. first appeared. By 1868 an impressive array of various silicate brands was carried in stock, attesting to many new uses for the versatile chemical. In 1889 growing business in the midwest justified the opening of another silicate factory in Anderson, Ind.

Early experimentation had shown the adhesive qualities of silicates, but it wasn't until the 1890's, with the introduction of the corrugated shipping box, that the first real use was made of silicate as an adhesive. Related uses, such as laminating fibre sheets for box and wall board opened up almost simultaneously.

HIGH QUALITY HYDRANT

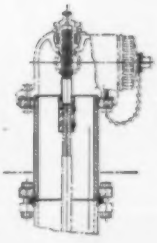
The R. D. Wood Standard Swivel Joint Hydrant with or without breakable flange and stem coupling

All Bronze Stuffing Box

Sound and simple in construction. It cannot rust or corrode. Hydrant operating thread can be greased or oiled by unscrewing one small plug.

Extension Piece

Can be inserted between hydrant head and barrel or between barrel and elbow. Installation does not require shutting off water supply.



R. D. WOOD

Public Ledger Building, Independence Square
Philadelphia 5, Pa.

In 1905 the out-dated silicate plant at Philadelphia was replaced by a new factory in Chester, Pa., to meet the increasing demand for silicate. At this time it was decided to concentrate the entire energies of the Philadelphia Quartz Co. on the manufacture of silicate. Soapmaking was accordingly discontinued.

On its 100th anniversary, the company introduced sodium metasilicate and sodium sesquisilicate. They have since become important basic alkalies in the chemical industry. In 1955, on the eve of this century-and-a-quarter mark, a new product, an amorphous finely divided silica, was announced. The new chemical is useful in pharmaceuticals and cosmetics, lubricating greases, varnishes and lacquers, printing inks, resins and plastics.

From the early days of experimentation in silicates to the modern Research Laboratories located at Primos, Pa., the company has issued a steady flow of technical information on the character and uses of silicates. Research continually points out promising new uses for the versatile, inorganic sodium and potassium silicates.

"Soluble Silicates, Their Properties And Uses," a two-volume publication by the late Dr. James G. Vail, a former director of the company, was released in 1952 by the American Chemical Society as its Monograph No. 116. It is the most complete treatise on this subject ever attempted.

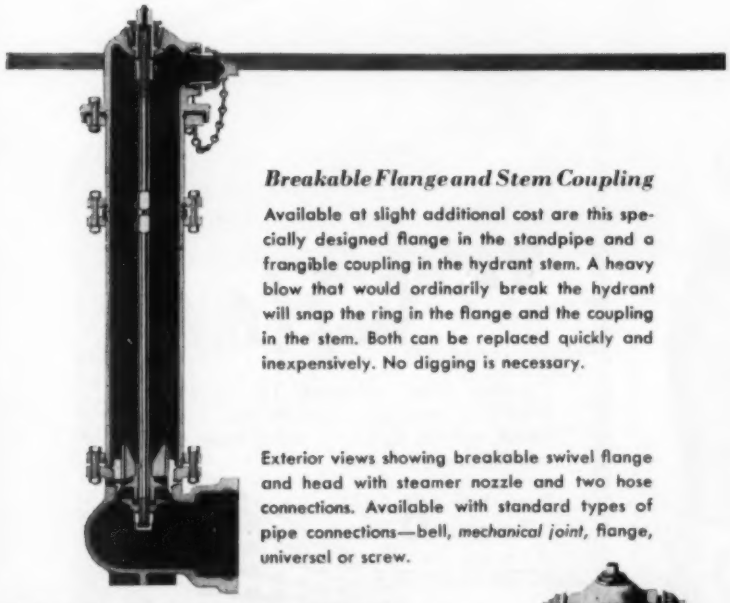
An early Philadelphia Quartz bulletin carried a wood cut engraving of the first plant

Today soluble silicates are used in such industries as soap, paper, textiles, refractories, paperboard, oil, rubber, laundry, television, ore flotation, foundry and metal cleaning. Applications not related to a specific industry include the prevention of corrosion in water lines, coagulation aids in raw and waste waters, the solidification of porous earth, catalytic gels, and concrete hardening.

In addition to the Anderson, Ind., and Chester, Pa., units, Philadelphia Quartz plants today are located at Baltimore, Md.; Buffalo, N. Y.; Jeffersonville, Ind.; Kansas City, Kan.; Rahway, N. J.; St. Louis, Mo.; and Utica, Ill. An associate company, Philadelphia Quartz Co. of California, operates three plants at Berkeley and Los Angeles, Calif., and Tacoma, Wash. Another associate is National Silicates Limited, with plant and office at Toronto, Canada. A new plant in Valleyfield, Quebec, will be constructed by the end of 1956.

AT LOWEST COST

The R. D. Wood Standard Swivel Joint Hydrant is designed to provide maximum strength and reliability at lowest possible cost. Internal friction, which can lower pressure, is reduced to the minimum, well below A.W.W.A. specifications. Changes of diameter are carefully rounded and nozzleways are scientifically tapered.



Breakable Flange and Stem Coupling

Available at slight additional cost are this specially designed flange in the standpipe and a frangible coupling in the hydrant stem. A heavy blow that would ordinarily break the hydrant will snap the ring in the flange and the coupling in the stem. Both can be replaced quickly and inexpensively. No digging is necessary.

Exterior views showing breakable swivel flange and head with steamer nozzle and two hose connections. Available with standard types of pipe connections—bell, *mechanical joint*, flange, universal or screw.

COMPANY

Manufacturers of "Sand-Spun" Pipe (centrifugally cast in sand molds) and R. D. Wood Gate Valves

Pickups from Purdue's Sanitary Engineering News

Don E. Bloodgood, Editor

A recent report says that bacteria in sewage did not utilize the synthetic detergents as a source of nutritive material unless there was a shortage of nitrogenous matter.

• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

W&SW

New Equipment

Five-Foot Lengths Of Clay Pipe Manufactured By Dickey

401

The W. S. Dickey Clay Mfg. Co., Kansas City, Missouri, has announced the manufacture of five-foot lengths of vitrified clay sewer pipe, in diameters from 15 through 36 inches, at five of its six plants. The production of five-foot lengths in these sizes at the Saspamco, Texas, plant will be started in 1956. Previously, pipe in these diameters was available only in lengths up to four feet.

According to Dickey, this new longer pipe has been developed to meet the needs of engineers, contractors, municipal purchasing agents and others interested in better sewerage and drainage. The longer lengths will speed up installation, reduce the number of joints to be formed, and reduce the number of pipe sections to be handled.

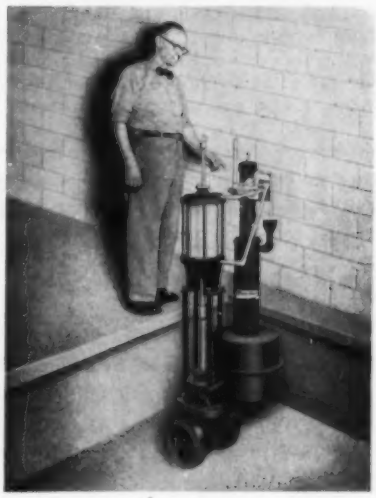
This new five-foot pipe gives users an advantage in crushing strength also, as it exceeds the minimum strength and other standards established by the American Society for Testing Materials, giving the engineer-designer an added safety margin.

Hydraulic Sewer Valve Prevents Sewer Back-up Flooding

402

Protection Equipment Co., Minneapolis, Minnesota, has developed the "Storm Guard" hydraulic sewer valve that provides completely automatic protection against main floor, basement, and low-level warehouse flooding when storms cause city sewer systems to back-up.

Available in six standard capacities for 4, 5, 6, 8, 10 and 12 in. sewers, the valve is positive in action, closing with



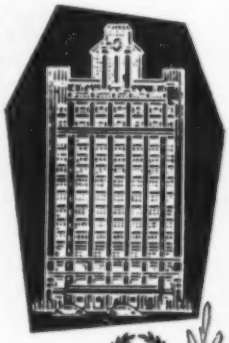
approximately 2000 lb pressure to shear paper, wood, toothbrushes, and

(Continued on page 90A)

FAMOUS AS
"THE HOSPITALITY HOUSE"
in New York City

Conveniently located in Times Square area. Parking facilities and all types of transportation nearby. 300 large rooms all with tub and shower. Rooms with pantrys available. Attractive Family Accommodations. Television. Air-conditioned restaurant and bar. Beauty Shops, Valet and Men's Shop, Drug Store.

from $4 single
all with bath



Hotel Carteret
23rd Street at 7 Avenue
Completely fireproof

down by the seashore

TATEM Surf Club

Carefree living enhanced by . . . large, cheerful guest rooms . . . private pool, ocean beach, cabana club . . . dining room and cocktail lounge.

Rates from $8 double, European Plan.

SELECTED CLIENTELE

Write for Booklet

On the Ocean at 43rd Street MIAMI BEACH

helping to mix a good, clear drink for 5 years

The city of Denver has, for many years, been noted for the purity of its drinking water. Transported from the western slopes of the Rockies through the famous Moffat Tunnel, the water is purified in the Moffat Filter Plant of the Denver Municipal Water Works.

It is here that *flexible* U. S. Pilot Pipe plays an important role – carrying the chemicals that purify the water–maintaining what is known as a good P.H. factor. This U. S. Pilot Pipe installation has given completely trouble-free service since the day it was put in. That was back in 1950–over five years ago.

With ordinary piping, lime in the chemicals builds up and clogs the pipe. But because U. S. Pilot Pipe is flexible, lime is easily broken loose by merely *tapping or walking the pipe!*

"U. S." specializes in products to handle corrosive chemicals and acids. These problems usually can be solved by such "U. S." products as Pilot Pipe, Uscolite®, Tank Linings, and Permobond® protective rubber lining.

Contact our factory trained engineers at any of the 28 "U. S." District Sales Offices or write us at Rockefeller Center, New York 20, N. Y.

US RUBBER

Mechanical Goods Division

United States Rubber

other materials that cause ordinary "flap type" valves to fail when needed most.

The design is simple. When the sewer level rises to the back-up danger point, a float in the "Storm Guard" valve rises. This float operates an arm which causes city water pressure to close the hydraulic shut-off valve. During a single storm this valve may automatically open and close several times. City water has been used for operation of the valves because it is the most dependable of all power during the time of a storm.

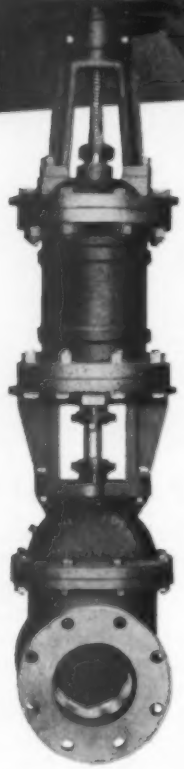
Strainers And Air Eliminators For Use With Liquid Meters

403

Rockwell Manufacturing Co., Pittsburgh, Pa., has announced that the completely redesigned models of the company's line of strainers and air eliminators for use with liquid meters offer new "straight-through" flow, greater ruggedness and increased versatility.

Chief advantages of the new strainers are larger screening area and new double-basket construction which protects the inner screen from being stretched or distorted by fast-moving large particles. The new strainers are available in both in-line and angle models.

The features of the new air eliminators include easy access to all working parts and in-line outlet and inlet connections. Access to working parts is achieved simply by removing four bolts in the valve body flange and lifting out the air-release valve assembly. Service work requires only the use of simple hand tools.



EASY OPERATION WITH

CYLINDER OPERATED

M&H VALVES

Cylinder operation is available for all sizes and all pressure classes of M & H Gate Valves. The cylinders are furnished either seamless brass, or cast iron bronze-lined, and may be operated either by water, oil or air pressure. Cylinder operated valves are desirable for remote control, or where valves require frequent operation, or where the valve installation is not readily accessible. Size of the hydraulic cylinder depends on operating pressure available, size of valve and water pressure against valve gate.

For complete information, write, wire or telephone to

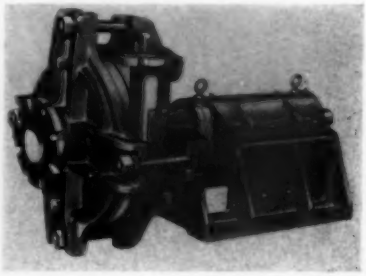
M&H VALVE AND FITTINGS COMPANY

Anniston, Alabama

M&H PRODUCTS FOR WATER WORKS • FILTER PLANTS INDUSTRY • SEWAGE DISPOSAL AND FIRE PROTECTION

Heavy-Duty Slurry Pump

404



Morris Machine Works, Baldwinsville, N. Y., has announced that a heavy-duty suction pump that is easily dismantled has been added to its line of slurry pumps.

This low-speed, continuous duty pump is designed to handle abrasive slurries, sludges, and other products up to the maximum fluid consistency under suction lift or positive head. An all-metal pump, the Type Q is available in seven different models from 2- to 6-inch size.

By removing only four bolts, this new pump can be opened for most maintenance requirements without disturbing the piping. External vanes on both sides of the impeller prevent packing between the impeller and casing. The impeller is pressure balanced to prevent recirculation; and is threaded to the shaft and sealed against corrosive action.

Redesigned Gate Valve

405

Crane Co., Chicago, Ill., has announced that it has redesigned and is marketing its No. 430 125-pound brass, rising stem, double wedge, disc gate valve. The valve is recommended for general service on steam, water, oil or gas lines. It comes in sizes ranging from ¼ inch through 3 inches.

The new design complements other companion valve of the same line.

The body neck in the new design

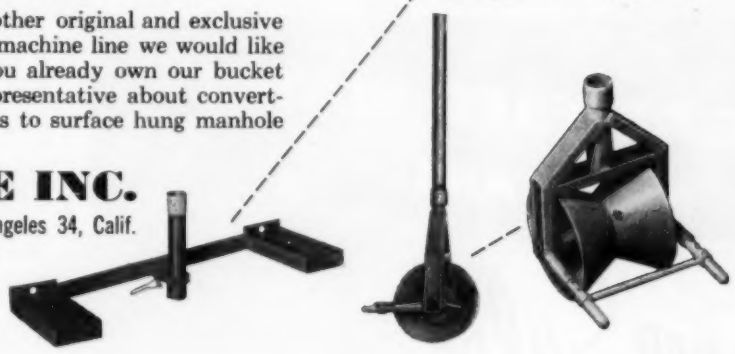
(Continued on page 92A)

ANOTHER "Flexible" Time-Saving Original!

Surface-hung Manhole Rollers! Just one of *many* "Flexible" contributions to faster, safer, more economical sewer cleaning.

Wasted hours setting rollers at bottom of manhole are eliminated, because entire set-up is now made above ground in minutes. And it takes no longer to set the rollers in water-filled, irregularly shaped or loose brick manholes that were *"impossible" with old style roller jacks.*

There are many other original and exclusive features in our bucket machine line we would like to tell you about. If you already own our bucket machines, ask your representative about converting your manhole jacks to surface hung manhole rollers.



FLEXIBLE INC.

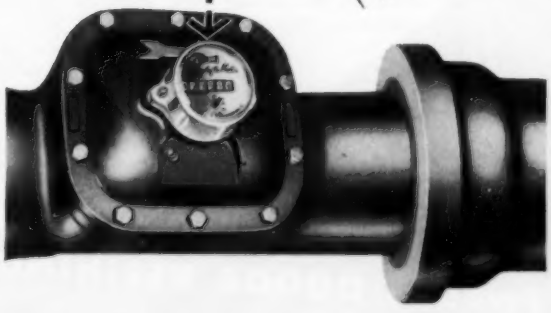
3786 Durango Ave., Los Angeles 34, Calif.

(Distributors in Principal Cities)

PATENT NO. 2,689,705

don't surmise... totalize!

Builders-Providence PROPELOFLO® is a direct-reading, propeller-type meter designed for main line totalizing of water consumption . . . available in 2 to 20 inch sizes . . . with flanged, bell and spigot, and threaded ends. Rated capacities range from 15 to 5800 gpm . . . accurate to within plus or minus 2% of actual flow. For complete information, write to Builders-Providence, Inc., 350 Harris Ave., Providence 1, Rhode Island.



B-I-F

B-I-F INDUSTRIES

PROVIDENCE, RHODE ISLAND

BUILDERS IRON FOUNDRY • PROPORTIONEERS, INC.
BUILDERS-PROVIDENCE, INC. • OMEGA MACHINE CO.

B-I-F METERS FEEDERS CONTROLS

is cylindrical. The design offers maximum strength in the body structure, thus eliminating the need for massive wall sections.

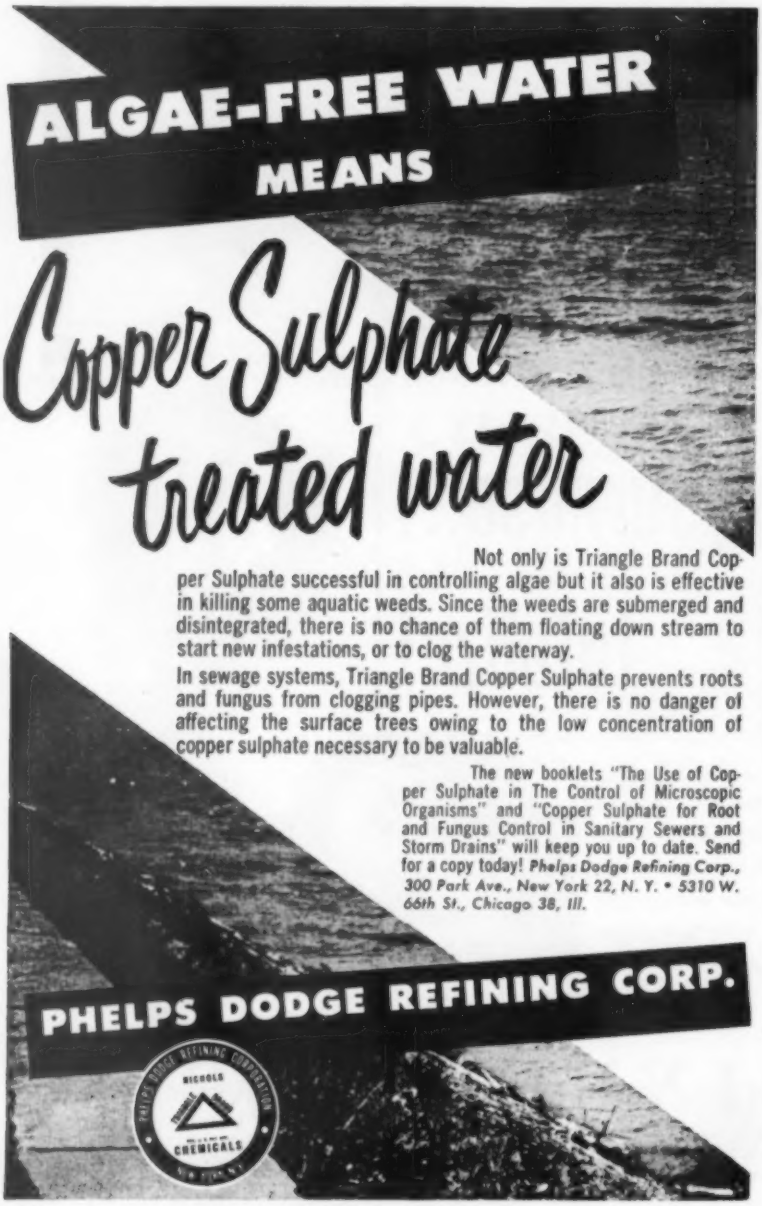
Stainless Steel Well Points

406

Edward E. Johnson, Inc., St. Paul, Minn., has announced the development of a stainless steel well point. Made of type 304 stainless steel, the well point is exceptionally strong to resist heavy driving and has the corrosion resistance of the high-grade 18-8 stainless alloy. The well point is a companion product to well points of Everdur that this company has manufactured for a number of years.

Stainless steel well points are made with continuous slot openings for maximum inlet area per foot of length. The V-shaped slots are non-clogging. The screen may be acid-treated in place and is not subject to galvanic corrosion.

The stainless steel well points are made in proper sizes to connect to 1¼-inch, 1½-inch and 2-inch standard pipe. They are manufactured with any length screen and with any slot opening from 0.006-inch to 0.125-inch in width.


ALGAE-FREE WATER
MEANS
Copper Sulphate
treated water
Not only is Triangle Brand Copper Sulphate successful in controlling algae but it also is effective in killing some aquatic weeds. Since the weeds are submerged and disintegrated, there is no chance of them floating down stream to start new infestations, or to clog the waterway.
In sewage systems, Triangle Brand Copper Sulphate prevents roots and fungus from clogging pipes. However, there is no danger of affecting the surface trees owing to the low concentration of copper sulphate necessary to be valuable.
The new booklets "The Use of Copper Sulphate in The Control of Microscopic Organisms" and "Copper Sulphate for Root and Fungus Control in Sanitary Sewers and Storm Drains" will keep you up to date. Send for a copy today! Phelps Dodge Refining Corp., 300 Park Ave., New York 22, N. Y. • 5310 W. 66th St., Chicago 38, Ill.
PHELPS DODGE REFINING CORP.
PHELPS DODGE REFINING CORPORATION
NICHOLS
CHEMICALS

Triangle Plastic Pipe Approved By National Sanitation Foundation

407

Triangle Conduit & Cable Co., Inc., New Brunswick, New Jersey, has announced that all plastic pipe manufactured by the company will now bear the approval seal of the National Sanitation Foundation, Ann Arbor, Michigan. The purpose of this seal is to allow users to differentiate between plastic pipe made from top-grade virgin material and pipe made from inferior scrap material. The awarding of the seal to Triangle is the result of an intensive two-year series of tests by the Foundation. Triangle's plastic pipe, as well as the plastic pipe of a number of other manufacturers, was thoroughly tested during this period. The National Sanitation Foundation will soon release the results to public health officials and water companies across the country.

Water Treatment Controller For Cooling Water Systems

408

Heller Laboratories, Inc., Leonia, N. J., has developed Hydrotrol, which is said to employ a new concept in regulating mineral concentration and chemical feed in recirculating cooling water systems.

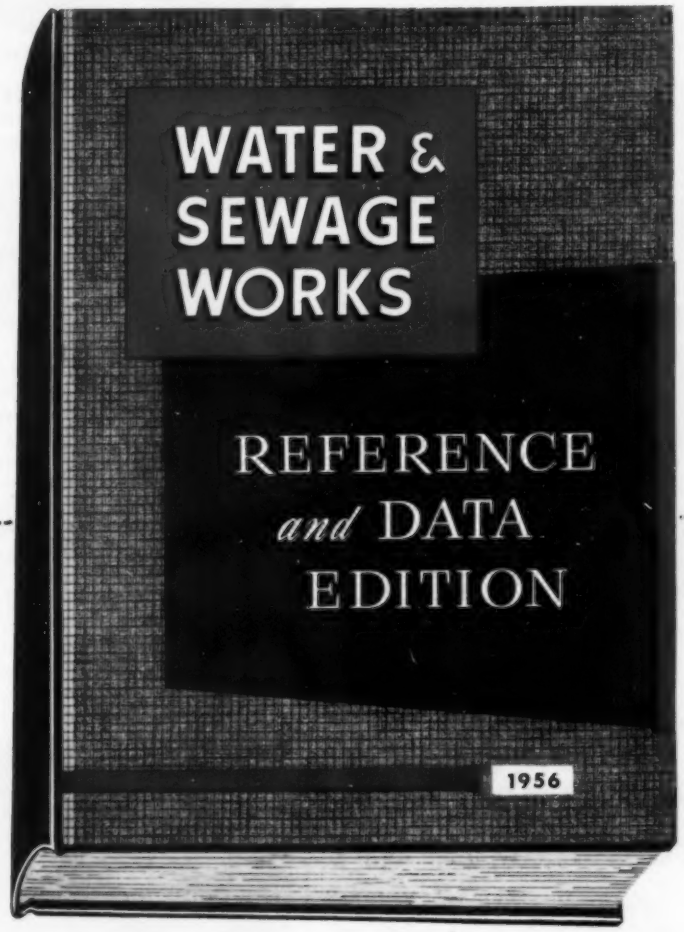
Hydrotrol is said to maintain a fixed range of mineral concentration, precisely as desired, and at the same time feed chemicals accurately, according to desired feed settings. The device makes possible the successful treatment of any recirculating cooling water system, without frequent compensating adjustments and close attention by a water treatment specialist.

(Continued on page 94A)

Now.....

You can have a superbly printed version of this famed REFERENCE AND DATA EDITION in a silk-screened hard cover binding

AN IMPRESSIVE LIBRARY VOLUME



Every word of the original text and every illustration will be included in this special limited edition, and the handsome, hard-cover binding will give it permanent protection against the effects of constant reference use. While every subscriber receives a copy of the regular soft-bound Reference and Data Edition at no extra cost as part of his subscription, so much interest has been expressed in hard-cover bound copies that we are making a limited number of them available this year (for the first time) to subscribers and non-subscribers alike.

The supply of these new hard-cover bound copies is very

Strictly Limited

and we will accommodate requests in the order we receive them. To make sure to get your copy, please enter your order NOW.

FILL IN AND MAIL THIS COUPON TODAY

Scranton Publishing Co. • 185 N. Wabash Ave. • Chicago 1, Ill.

Gentlemen:

Please send me _____ copies of the SPECIAL silk-screened, hard-cover bound Reference and Data Edition for 1956 at $3.00 each.

Name_____

Company_____

Address_____

City_____ Zn_____ State_____

Send bill to:_____ Payment enclosed

After the desired chemical feed and mineral concentration range are determined and set, Hydrotrol operation is entirely automatic. Any range of mineral concentration, up to 100 cycles of concentration, can be maintained. A wide range of chemical feeds can be precisely maintained.

New Automatic Sampler

409

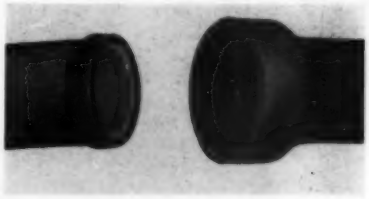
Denver Equipment Company, Denver, Col., has introduced a new automatic sampler with end carriage to provide accurate sampling results in normally inaccessible places.

By taking the whole of the stream part of the time, this sampler eliminates errors resulting from variations across the stream. Constant intervals between cuts are maintained to obtain equal representation of the entire length of the stream.

The intermittent operation of the sampler is controlled by a Telechron motor-driven time switch, which may be set for intervals of from 2 to 55 minutes in 1-minute increments. Sampling interval is easy and simple to set and can be adjusted to insure representation in the sample of the most abrupt changes in the stream.

New Plastic Jiffy Joint Clay Pipe

410



Cannelton Sewer Pipe Co., Cannelton, Ind., has announced a new plastic-jointed vitrified clay sewer pipe—Plastic Jiffy Joint Pipe.

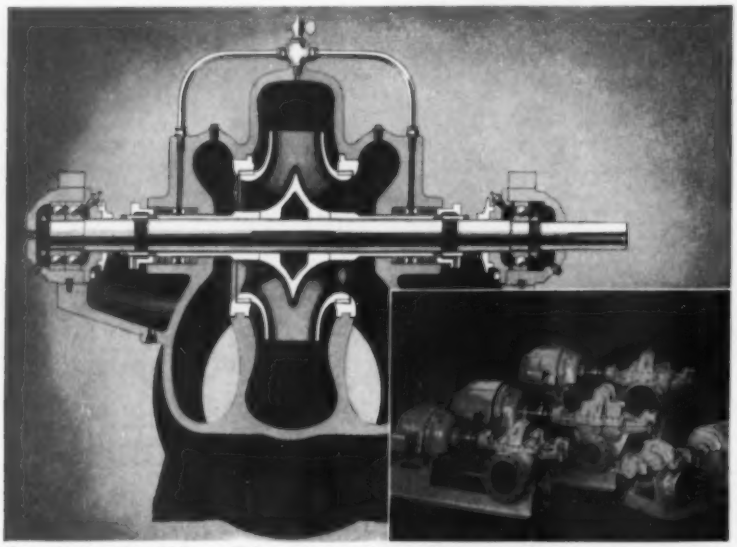
The new pipe is said to be lower in original cost than any other plastic-jointed clay pipe, and it can be installed faster than any other clay pipe of any type.

The new joint is made of bright red polyester plastic, die-cast permanently on the spigot end of the pipe at the factory. The bell end features a precision-cast bituminous socket that provides the flexibility needed for permanently tight joints. Plastic Jiffy Joint can be stored indefinitely under the blazing sun with no danger of softening or deformation of the spigot joint. In addition, the plastic collar doubles the impact strength of the spigot end, so that careless handling does not result in high breakage loss.

Lightweight Sewer And Drain Pipe

411

Carlon Products Corp., Cleveland, Ohio, has announced an increased demand for Carlon "D" lightweight plastic pipe for use in sewer and drain applications.



Cross Section Type M Pump. This construction is used, with minor variations, in all sizes 4" and larger.

Group of Double Suction Pumps ready for installation in municipal water works.

Worry-Proof

YOUR PUMPING PROBLEMS with WHEELER-ECONOMY PUMPS

This cut-away section of a Wheeler-Economy Type "M" Pump shows engineering that means around-the-clock, around-the-calendar performance . . . peace of mind for the men in charge. Longer life and less maintenance work results from these important features . . . The method of supporting the rotor between outboard bearings with end-thrust practically eliminated . . . horizontally split casing with all pipe connections in lower half so that rotating parts can be removed without disturbing connections or pump alignment . . . Inlet designed to reduce leakage and friction losses . . . Double-bearing construction provides for longer packing life . . . Low pressure stuffing boxes . . . Wearing parts readily renewable.

To insure correct application for your municipal or industrial project, Wheeler-Economy offers specialized engineering service as well as a wide selection of pump sizes and cases. Write for CATALOG A-1052.

WE-512

WHEELER-ECONOMY PUMPS

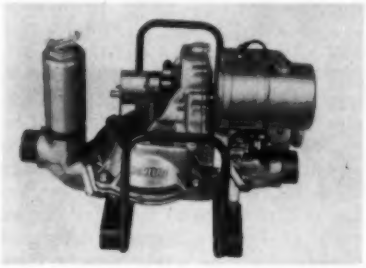
ECONOMY PUMPS, INC. · DIVISION OF C. H. WHEELER MANUFACTURING CO.
19TH AND LEHIGH, PHILADELPHIA 32, PA.

According to the company, one man can install 100 feet of Carlon pipe in 40 minutes with nothing more than a saw and a can of quick-setting cement. Another feature of this pipe is that it can be compressed to 75 per cent of its normal diameter and still return to its original form. This characteristic is valuable when pipe must be laid beneath heavy truck and machinery traffic.

Carlon "D" plastic pipe comes in full 10-foot lengths in 2- to 6-inch sizes with a complete line of reducers, adaptors and couplings for special sizes and angles for coupling to other types of pipe.

Easily Handled Diaphragm Pump

412



Homelite, Port Chester, New York, has developed a new diaphragm pump designed for all heavy-duty pumping of mud, muck, sand and sewage.

Easy to carry and move around, the new pump weighs only 120 pounds and will run 6 hours at full capacity pumping on one gallon of fuel. The throttle on the float-type carburetor can be hand regulated to adjust engine speed for different pumping conditions — slow speed for seepage control, full speed for capacity pumping.

According to the company the pump will dry-prime up to 15 feet in 15 seconds. Pumping capacity is 5,000 gallons per hour; guaranteed suction lift, 28 feet; and total head, 50 feet, including friction.

Timer Valves Control Flow Automatically

413

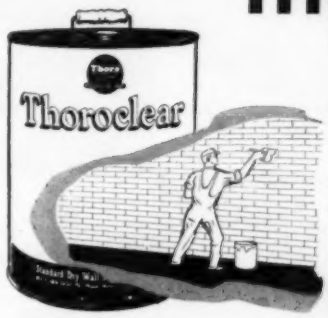
Automatic Controls Corp., Ann Arbor, Michigan, has developed a series of new timer valves that automatically control the flow of liquids, gas, or air. The units consist of a solenoid valve and a timer control sealed in a watertight case.

These timer valves turn the flow on or off at desired time intervals, and are available in a wide variety of timing cycles. The valves can be used to turn a flow either on or

(Continued on page 96A)

The THORO System
of Masonry Protection

THOROCLEAR



Invisible Water Repellent

Ask your dealer about this powerful silicone water repellent developed by years of research by General Electric Company and now produced by us for your protection. *Ask for Circulars No. 30 and 31.*

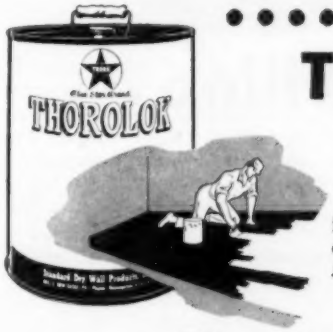
No change in color or texture of brick, limestone, sandstone, tile or stucco surfaces. Applied by brush or spray.

Keep water out of your masonry walls and protect interior plaster, paints and expensive furnishings.

THORITE

20 Minute Set Patching Compound

Repair those broken sills, steps, concrete floors, chimneys and other defective masonry! *Ask for circular No. 20.*



THOROLOK
NO. 100

Use it for your basement or factory floors. New, with special alkali resistant pigments. *Ask for Color Card 32-C.*

Manufacturers of

WATERPLUG, THOROSEAL, QUICKSEAL

for all types of masonry protection!

GET OUR PICTORIALLY DESCRIBED LITERATURE "HOW TO DO IT"

STANDARD DRY WALL PRODUCTS, INC.
NEW EAGLE, PENNSYLVANIA

off, or both on and then off, at any desired time. They can perform this function each day with repeat cycle operation—no re-setting is needed. They can also be used to obtain continuously intermittent operation.

Deflection Indicator

414

Allis-Chalmers Manufacturing Co., Milwaukee, Wis., has developed a magnetic-amplifier type deflection indicator, applicable to any equipment in which early detection of relative movement is desirable.

The indicator is designed to safeguard hydrostations, compressor and pumping stations, drive shafts and other applications. A 60-cycle, 110-volt power source and a suitable location for mounting two compact inductor-coil pickup units are its only requirements.

The indicator offers potentials for both remote and local operation. In either instance, visual or audible alarm systems can be activated to call attention to deflection or motion.

have you met

Mr. Centriline . . .

If not, you should! He can do things for you . . . like making your job easier and saving you money. He's a versatile and somewhat ingenious many-armed creature who specializes in cement-mortar lining the inside of pipes. And he's done this to over 4 million feet of pipe, too—eliminating corrosion and tuberculation . . . increasing flow capacity . . . reducing leakage . . . slashing pumping costs . . . and adding years and years of pipe life. If you'd like to learn more about Mr. Centriline and how he can work for you, just write or call for one of our descriptive brochures.

CENTRILINE CORPORATION

A subsidiary of the Raymond Concrete Pile Company

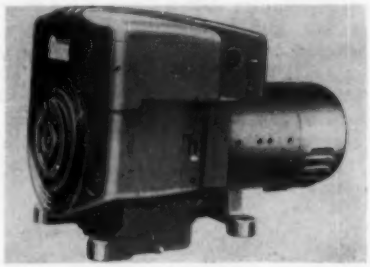
140 CEDAR STREET
NEW YORK 6, N. Y.
WOrth 2-1429

Branch Offices in Principal Cities of the United States, Canada and Latin America

• CEMENT-MORTAR LINING OF PIPES IN PLACE •

New Air-Cooled Electric Plants

415



D. W. Onan & Sons Inc., Minneapolis, Minnesota, has announced two new electric generating plants, in 3,500- and 5,000-watt A.C. sizes.

Both of these newest electric plants in Onan's modern heavy-duty line of generating equipment are powered by a 2-cylinder gasoline engine, claimed to be the most compact in its horsepower range on the market today. For instance, the remote starting model, 305CCK, is 26⅜ inches long; Model 5CCK is only 29⅞ inches long. Both are 21⅛ inches wide and 20¾ inches high. The opposed cylinder design of this 4-cycle, air-cooled engine makes the generating plants ideal for installations where quiet, smooth running performance is essential and where installation space is at a premium.

Both of these two generating plant series are available in 60- or 50-cycle; 115, 230, or 115/230-volt, single phase, and 230-volt, 3-phase, 3-wire.

New Improved Unitube Tow-Bro Sludge Collector

416

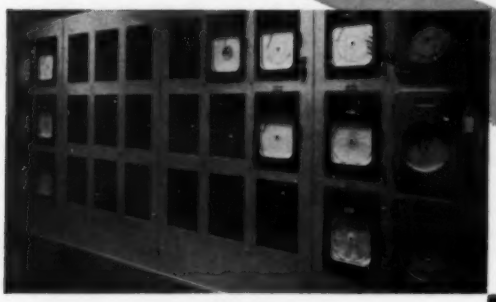
Chain Belt Company, Milwaukee, Wis., recently introduced a new sludge remover mechanism called the Unitube Tow-Bro. Increased efficiency at lower costs are the chief advantages of the new Unitube.

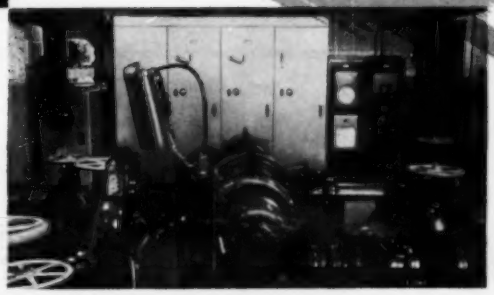
The original Tow-Bro was manufactured by Chain Belt Company in 1929. This unit consisted of tubular arms that swept the bottom of clarifier tanks, collecting settled sludge through flared nozzles and headers. The most recent design is made up of a single tapered header arm that is rectangular in cross section. Unitube

(Continued on page 98A)

to SEE and DO...

over the miles





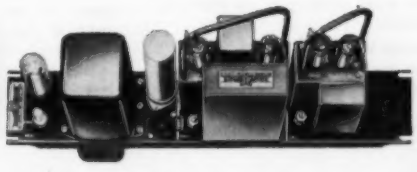
DO IT THE PRACTICAL WAY

with HAMMARLUND

Centralized Operations Control

You can control hard-to-reach points in your water system from a central location with dependable Hammarlund Centralized Operations Control equipment. COC units act as the link between various substations and main office, utilizing a standard telephone pair to convey telemetering information or to carry control and supervisory indication signals. Pumps, motorized valves, or any other mechanized equipment can be directly or proportionally controlled, and flow, level, and pressure readings can be telemetered—simultaneously! With Hammarlund COC equipment installed in your present system, you can greatly increase your services without increasing your costs by utilizing in most instances, your **present** equipment and personnel. COC is extremely economical. In most installations it has paid for itself in less than two years. For complete details, write for Bulletin WSW-456.

COC equipment is made up of Dual Signalling Units, Single and Dual Transmitter Units, and Single and Dual Receiver Units mounted on standard 19" panels. With this design, additional functions can be achieved with Hammarlund's add-a-panel packaging — without re-engineering the existing control system.



Established 1910

HAMMARLUND

MANUFACTURING COMPANY, INC., 336 West 34th Street, New York 1, N. Y.

INTERNATIONAL DIVISION: 13 East 40th Street, New York 16, N. Y.

has a peaked roof with orifices on the collector that face downward and into the sludge. Balance between the taper of the tube and increasing orifice sizes insures uniform flow velocities in the tube and positive sludge removal from the entire tank bottom.

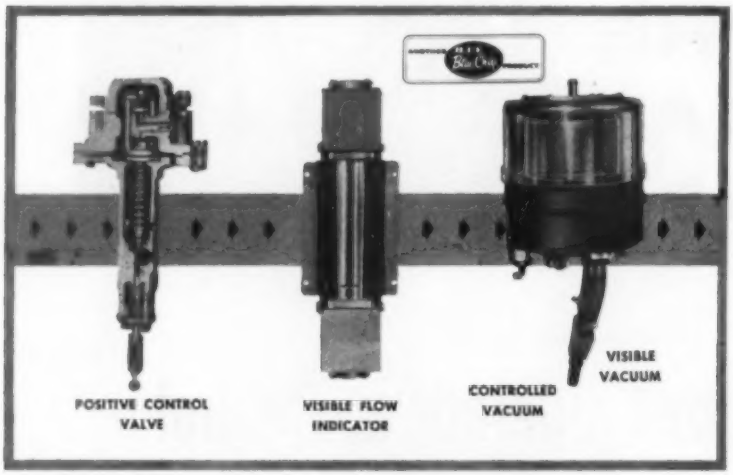
Unitube is easily adapted to any tank and all plant conditions.

Template Kit For Piping And Valving Systems

417

A. Lawrence Karp, Greenwich, Conn., has available a new matched set of five reversible templates for laying out any valving and piping system in a fraction of the usual time. Containing all American Standard symbols, the templates have provisions for new or special symbols. It is claimed to be the most complete diagramming outfit devised for such work.

At least 5,000 commonly used pipe, fittings, and valve diagrams can be pencil drawn with great accuracy by using the cut out symbols on the templates singly or in combinations. Layouts can be used for any fluid processes.



IN CHLORINE GAS FEEDERS . . .

LOOK FOR KNOW-HOW

Here's proof of good chlorine feeder design! The gas flow path shown in this Builders-Providence flowgram is the shortest offered by any manufacturer of chlorination equipment . . . and we invite comparison! Good design means maximum dependability (to the consulting engineer) . . . ease of installation (to the contractor) . . . and easy operation, low upkeep, and low operating cost (to the operator).

Our design offers all these and more. For added safety . . . there are no springs or piloted parts in contact with chlorine, no packed valve stems to leak and destroy feeding accuracy . . . and the simplicity of the entire system means better operation with less maintenance.

These superior features did not just happen — but are drawn from the vast reservoir of B-I-F application knowledge and experience gained as the major manufacturer of flow metering, and control equipment for WATER, SEWAGE, and WASTE TREATMENT PLANTS. Many consulting engineers have profited by the valuable assistance received from B-I-F specialists. Our policy of continuing research and development has produced the most comprehensive, service-proven line available . . . and thousands of superior performance records reflect our broad design and manufacturing experience.

• • •

If you have a chlorine gas feeding problem, our engineers will gladly help you solve it. A call to GAspee 1-4302 in Providence . . . or to one of our local offices . . . will put us at your service. B-I-F Sales and Service Offices are located across the country for your convenience. Act today! Builders-Providence, Inc., 350 Harris Avenue, Providence 1, Rhode Island.

B-I-F INDUSTRIES

PROVIDENCE, RHODE ISLAND

METERS FEEDERS CONTROLS

High Capacity Air Volume Booster For Pneumatic Control Systems

418

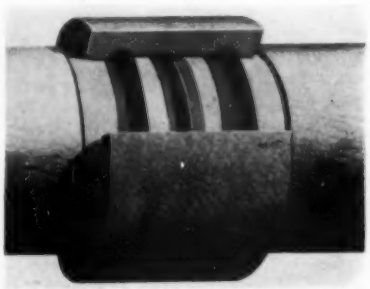
Governaire Division, Bellofram Corp., Burlington, Mass., has developed a new air volume booster with ⅝-inch diameter supply and exhaust seats that is said to result in maximum flow capacity, even at low pressure differentials.

Called "Governaire Series 4500," the new booster has a flow capacity of 115 cfm, when signal pressure is 10 psi and supply pressure is 50 psi. The unit is capable of handling supply pressures up to 250 psi, signal or output pressures to 150 psi.

The new booster is for speeding response of air cylinders, or diaphragm valves. It may also be used to shorten time-lag caused by long transmission lines. A signal chamber volume of only about 1½ cubic inches is provided for small capacity signal sources. Maximum signal pressure change needed to initiate output change is less than one inch of water.

Coupling For Water Pressure Mains

419



Keasbey & Mattison Company, Ambler, Pa., has developed a new coupling for water pressure mains that is said to make possible the laying of more "Century" asbestos-cement pipe per hr than ever before and insure permanent water-tight seals.

Introduced under the name "Fluid-Tite," the coupling consists of an asbestos-cement sleeve with two circumferential grooves in the bore and two taper-molded rubber sealing rings with holes in their inner faces. In assembling a pipe joint, the rings are placed in the grooves, and the pipe ends are inserted in the coupling. Fluid under pressure in the pipe enters the holes and expands the rings against the pipe and coupling walls.

According to the manufacturer, "Fluid-Tite" joints can be assembled without coupling pullers on pipe in sizes up to and including 8 in.

New Subscription Order Card

NOTE THE NUMBERS
they correspond with the
headings in our
EQUIPMENT AND LITERATURE COLUMNS
To receive further information
on any of the listed
EQUIPMENT OR LITERATURE
just circle the corresponding
numbers on the card
Fill in your name, address, title
and mail!
For your convenience these
cards require no postage.

Water & Sewage Works

185 NORTH WABASH AVE. CHICAGO 1, ILL.

Gentlemen:

Please enter my new subscription to WATER & SEWAGE WORKS for the period checked below:

☐ Three Years—$6.00 ☐ Two Years—$4.50 ☐ One Year—$3.00

Above rates are for U.S.A. and Canada. Add $1.50 per year for other countries.

Name .....
Title or Position .....
Company or Govt. Dept. .....
Address .....
City ..... Zn. ..... State .....

***PLEASE SEND ME INFORMATION ON THE ITEMS CIRCLED BELOW**

401	402	403	404	405	406	407
408	409	410	411	412	413	414
415	416	417	418	419	420	421
422	423	424	425	426	427	428
429	430	431	432	433	434	435

IF YOU WISH TO RECEIVE FURTHER INFORMATION ON PRODUCTS ADVERTISED OR REFERRED TO IN THE ARTICLES, OF THIS ISSUE—LIST THE PAGE AND ITEM BELOW.

_____

_____

_____

_____

_____

Your Name .....

Title .....

Company or Dept. .....

Address .....

.....

*ITEMS LISTED NOT SERVICED AFTER JUNE 30, 1956

No Postage Stamp Necessary If Mailed in the United States

BUSINESS REPLY CARD
First Class Permit No. 43608, Sec. 34.9, P.L.&R., Chicago, Ill.

WATER & SEWAGE WORKS
185 NORTH WABASH AVENUE
CHICAGO 1, ILLINOIS

Postage Will Be Paid By Addressee

No Postage Stamp Necessary If Mailed in the United States

BUSINESS REPLY CARD
First Class Permit No. 43608, Sec. 34.9, P.L.&R., Chicago, Ill.

WATER & SEWAGE WORKS
POST OFFICE BOX 35
VILLAGE STATION
NEW YORK 14, NEW YORK

Postage Will Be Paid By Addressee

New Subscription Card
for
WATER & SEWAGE WORKS

JUST CLIP THESE CARDS MARK AND MAIL— TO RECEIVE THE LATEST INFORMATION OR LITERATURE DESCRIBED IN THIS ISSUE

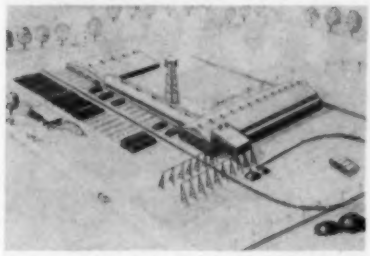
READER SERVICE CARD for
WATER & SEWAGE WORKS

Equipment — Products
Information — Literature

W & SW

Manufacturer's News

Clow To Build Cast Iron Pipe Plant In Chicago Area



James B. Clow & Sons, Inc., Chicago, Ill., has announced a $5,000,000 expansion program of its manufacturing facilities.

Central project in the expansion is a new cast-iron pipe plant to be built in Bensenville, Ill., which will give Clow a major pipe producing facility in the heart of the expanding Midwest market. First of its type to be built in the Chicago area, the plant will have a capacity of producing 80,000 tons of pipe a year.

Located on a 58-acre site on Irving Park Road at the Cook and DuPage County line, it will provide some 150,000 square feet of floor space, adjacent to railroad facilities. The main part of the building will house melting units, machine shop, and casting operations. A wing of the structure will house facilities for annealing, finishing, and testing the pipe.

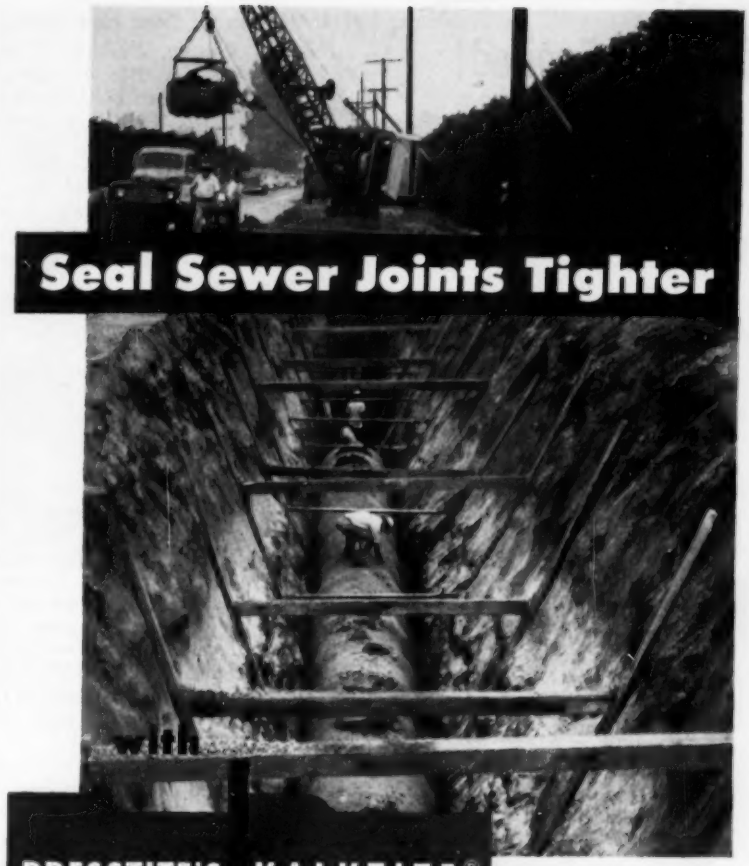
MacKay Appointed Sales Manager Of Acipco

The American Cast Iron Pipe Company, Birmingham, Alabama, has announced the election of Mr. J. W. MacKay as vice president, sales manager and secretary of the company. He succeeds A. J. Herrmann who has been elected executive vice president of the company.

Mr. MacKay has been general sales manager since December 1955. He has been connected with American Cast Iron Pipe Company since 1936.

A native of Asheville, N. C., he was graduated from Danville, Va., Military Institute and the University of Alabama.

(Continued on page 100A)



. . . meets Federal Specification SS-S-168

Over the past 30 years, the Presstite Sealing System has been thoroughly service-proved by many leading engineers and contractors. They will assure you it's the easiest, most economical way to get strong, tight joints that eliminate practically all ground water infiltration.

PRESSTITE'S 3-STEP SEALING SYSTEM

PRIMER	Improves bond between pipe and sealing compound.
ROPAX®	Non-porous, adhesive packing. Compresses to form additional seal impervious to water.
KALKTITE®	Cold mixed and cold applied. Dense, flexible, asphaltic cement. Sets internally; unaffected by hot, cold, wet or dry conditions.

WRITE for working samples and 20 page catalog.

PRESSTITE Sealing Compounds

Sealing Compounds Exclusively Since 1924

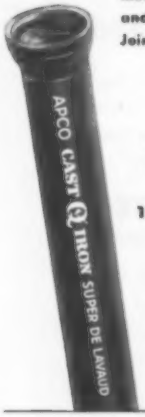
PRESSTITE ENGINEERING COMPANY

3780 Chouteau Ave. • St. Louis 10, Mo.

I'm Spoiled!

I'm brought into this world in the most modern home a pipe ever had. I'm even checked on before I'm born . . . metallurgy, I am told. Then I run a gamut of tests . . . weight, thickness, hardness and several kinds of pressure tests . . . They take no chances on me. I'm their pride and joy . . . Their reputation depends on me. You see, I'm Alabama's Super De Lavaud Cast Iron Pipe. I'm produced to give dependable service for a long, long time.

Specify Alabama's Super De Lavaud Cast Iron Pipe. Sizes of 3" to 24" in modern long lengths. Bell and Spigot, Flanged Roll-on-Joint, and Mechanical Joint.



We invite inquiries to our nearest sales office—

122 So. Michigan Avenue
Chicago 3, Ill.

350 Fifth Avenue
New York 1, New York

General Sales Offices

ALABAMA PIPE COMPANY

ANNISTON, ALABAMA

H. L. Weston Of "Red Hed" Dies

Henry L. Weston, President of the Red Hed Mfg. Co., Boston, Mass., died on January 31, 1956, at Quincy, Mass.

Mr. Weston, a native of Duxbury, Mass., was one of the founders in 1923 of the Red Hed Mfg. Co. along with Morton L. Miller and Joseph G. Lufkin. He entered the water works supply field in the early 1900's with the Kennedy Valve Co. In 1908 he became associated with the National Meter Co. of Brooklyn, N. Y. For many years he represented this company in New England in their water-meter division. In 1941 the National Meter Co. merged with the Pittsburgh Equitable Meter Co. and Mr. Weston continued his activities with the combined companies until 1946 when he resigned to devote his entire energies to the Red Hed Mfg. Co. In 1952 he became president of the company, which office he actively held until his death.

Newton Named Sales Manager Of White Diesel Engine

The White Diesel Engine Division of the White Motor Company, Springfield, Ohio, has announced that J. H. Newton has been appointed Sales Manager of the Diesel Division.

Mr. Newton received a degree in engineering from the University of Illinois and the Chicago Technical Institute, after which he has been associated with the heavy-duty diesel engine industry in sales for the past 19 years. He joined the Diesel Engine Division sales activity in Springfield, Ohio, in 1948 and prior to that time he developed a broad background in diesel experience during 12 years' association with Fairbanks, Morse and Company.

Wilber Promoted By Bailey Meter

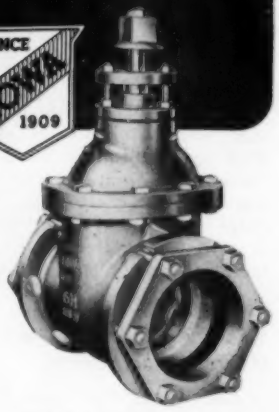
Bailey Meter Company, Cleveland, Ohio, has announced that John J. Wilber has been appointed Manager of the company's Cleveland district sales office. He suc-

IN EVERY WAY A SOUND CHOICE . . .

Specify IOWA for . . .

- Gate Valves
- Tapping Sleeves and Valves
- Check Valves
- Indicator Post Valves
- Square Bottom Valves
- Hydraulic Valves Motor Operated
- Shear Gates
- Fire Hydrants
- Mud Valves
- Flap Valves
- Sluice Gates
- Floor Stands
- Valve Accessories

SINCE IOWA 1909



We manufacture complete equipment for water and sewage flow control in Filtration Plants, Sewage Disposal Plants and Pumping Stations. Specify Iowa and let us solve your problems.

IOWA VALVE COMPANY
OSKALOOSA, IOWA
A subsidiary of James B. Clow & Sons

ceeds C. C. McCelland, who retired the first of the year.

A 1939 graduate of Case Institute of Technology, Wilber received a B. S. Degree in mechanical engineering. He started with the company in 1941 as a sales-service engineer and was assigned to the Cleveland district office.

Herrmann Elected Executive Vice President Of Acipco

The American Cast Iron Pipe Company, Birmingham, Alabama, has announced the election of Arnold J. Herrmann as executive vice president of the company.

Mr. Herrmann, a veteran of 41 years continuous service with the company, joined Acipco on August 14, 1914, when he was employed in the machine shop. Prior to this he had worked as a water boy in the carpenter shop during the summers of 1910 and 1912.

Upon leaving the machine shop, he subsequently worked in the traffic and billing department, laboratory, sales department and loading yard. His longest service, in the sales department, takes in 21 years as manager of Acipco's Kansas City branch office. He returned to Birmingham from this assignment in June, 1952, to take the job as assistant general sales manager, which position he held until the following year when he was elected vice president in charge of sales.

Burke Appointed Kansas City District Manager By Beaver

Beaver Pipe Tool, Inc., Warren, Ohio, has announced the appointment of Gordon Burke as District Manager of their Kansas City sector. This includes Missouri, Kansas, Nebraska and Iowa. Headquarters are in Kansas City.

Burke, a native of the Midwest, comes to Beaver with a good background in mechanical engineering and experience in working with distributors and users of pipe tool equipment.

Swift Named Secretary By Yeomans

Yeomans Brothers Company, Melrose Park, Illinois, has announced that Arthur D. Swift has been named Secretary of the company.

A graduate of the Colorado School of Mines, and a registered professional engineer in Illinois, Mr. Swift joined the firm's sales

(Continued on page 102A)

American Cities of every size are now overcoming ODOR problems with this new, economical and effective sanitation chemical.

In the treatment of raw sludge in storage tanks (1 gal. Cifon, N.Y. to 6000 gals. of raw sludge)—in the spray application at the vacuum filter exhaust and other vulnerable areas in the plant—and in the dosing of sand filter beds—CIFON, N.Y. has proven itself a positive odor-control agent. No special equipment or training of personnel required.

CIFON, N. Y. ***SERVES MUNICIPALITIES IN MANY WAYS***

GARBAGE DISPOSAL DUMPS When sprayed on garbage dumps in a dilution of 1 gal. to 100 gallons of water CIFON, N.Y. will counteract the odor of garbage, will prevent the generation of undesirable odors due to decomposition of garbage and prevent the breeding of flies.

SEWER SANITATION CIFON, N.Y. will remove slime, bacteria and fats in plugged up sewers through its solvent action, and will aid in the control of disease producing and carrying organisms.

GENERAL SANITATION CIFON, N.Y. repels flies and mosquitoes and prevents mosquitoes from breeding in marshy lands . . . Used for dousing garbage trucks and garbage scows.

***CIFON, N.Y.** *is an emulsifiable, sanitizing and deodorizing chemical—compatible with soap—contains no caustic, free chlorine or carbolic acid.*

FINE ORGANICS, INC. MAKERS OF CHEMICALS F.O.

FINE ORGANICS, INC.
211 EAST 19th STREET • NEW YORK 3, N. Y.

Mail handy coupon for complete information on how to solve ODOR problems in your city, quickly, efficiently, and economically. There is no obligation on your part.

FINE ORGANICS, INC., 211 E. 19th St. • Dept. 'WS' • New York 3, N. Y.

Gentlemen: Please send me information on CIFON, N.Y.

NAME_____

COMPANY_____

ADDRESS_____

CITY_____ ZONE_____ STATE_____

"GUNITE" LINING BY CEMENT GUN COMPANY RESTORES LARGE MUNICIPAL RESERVOIR

Increased demand for water and constant leakage in its principal reservoir presented a serious problem to the Water Department of a large Pennsylvania City.

Because of the urgent need to return the structure to service as quickly as possible, Cement Gun Company used four guns simultaneously throughout the restoration work. Construction joints were repaired and reinforced "GUNITE" lining placed over entire bottom and sides.

The relining of this 20 million gallon reservoir is a typical example of the many jobs performed quickly and economically by Cement Gun Company for municipalities and privately owned Water Companies throughout the United States.

A request on your letterhead will bring a copy of our latest Catalog C3000 which illustrates and describes the wide variety of "GUNITE" work performed by Cement Gun Company.

CEMENT GUN COMPANY
"GUNITE" CONTRACTORS
GENERAL OFFICES – ALLENTOWN, PA., U. S. A.

MANUFACTURERS OF THE "CEMENT GUN"

FROM WATER TO SLUDGE...

THE NON-LUBRICATED VALVES FOR ALL SEWAGE SERVICES!

DeZURIK EASY-OPERATING PLUG VALVES

are the *only* valves with the rubber-faced eccentric plug that closes down *tight* on water or sludge. Sewage "grease" can't pile up on the valve seat; there's no place for it to lodge inside the valve.

On any line — from sludge to solvent to water—DeZurik Easy-Operating Plug Valves are the non-leaking, non-binding, NON-LUBRICATED valves you've been looking for. Sizes from ½" to 20"; manual or remote operation.

Representatives in principal cities.

DeZURIK SHOWER COMPANY
Sartell, Minnesota

organization in 1934. During World War II he served as production manager, and since 1945 has been sales manager of the Chicago area sales office.

New Kenco Pump Plant Addition

The Kenco Pump Division of the American Crucible Products Co., Lorain, Ohio, has announced the construction of a new $100,000 building to meet the increased demand for Kenco products.

The new steel frame structure will be one story high and will be designed to permit expansion in the future. More than 17,000 square feet of space will be devoted to Kenco facilities.

The new Kenco building will be located adjacent to the American Crucible property. Company officials plan increased production, as well as the introduction of new pump models in the future.

De Laval Makes New Appointments In Chicago District

De Laval Steam Turbine Co., Trenton, N. J., has announced that W. H. Mouquin has been named District Manager of the Chicago office, and that C. C. Bray has been appointed Regional Sales Supervisor at the same office.

These appointments in the new Chicago sales and service headquarters in Forest Park, Illinois, are part of De Laval's continuing expansion of customer sales and service facilities.

Minneapolis-Honeywell Names Two To Field Sales Posts

Minneapolis-Honeywell Regulator Co., Philadelphia, Pa., has announced the appointment of Vince Tassi as industrial manager for Hartford, Conn., and Lyle Russell, industrial manager for Chicago.

Tassi, a 24-year veteran with the company, was formerly in the firm's New York sales office. Russell, a 10-year man, formerly had assignments in Boston and more recently was manager at Hartford.

Diamond Alkali Promotes Two Sales Executives

Diamond Alkali Co., Cleveland, Ohio, has announced that two veteran sales executives have taken over important new managerial responsibilities in the firm's recently-formed Electro Chemicals Division.

Mr. Clayton M. Holt, manager of

chlorine sales since October, 1941, has been made manager of chlorine and hydrogen sales. William L. McFadden, special staff assistant in the sales department for the past year and a half, has taken over the post of manager of caustic soda sales.

Holt brings to his new assignment 30 years of sales experience. He joined the technical staff of Diamond's Painesville plant in 1933. He was transferred to the company's general office in 1938, becoming a member of the sales staff. Three years later he was appointed chlorine sales manager.

McFadden joined the company as a laboratory technician following his graduation from Drexel Institute of Technology in 1938.

Called to military service with the U. S. Army in 1944, he returned to Diamond in 1946 as a chemist on the sales technical staff, advancing to sales and service representative in 1949 and to special staff assistant in 1954.

Foxboro Makes Sales Appointments In South

The Foxboro Co., Foxboro, Mass., has announced five new sales office appointments in the Southeast.

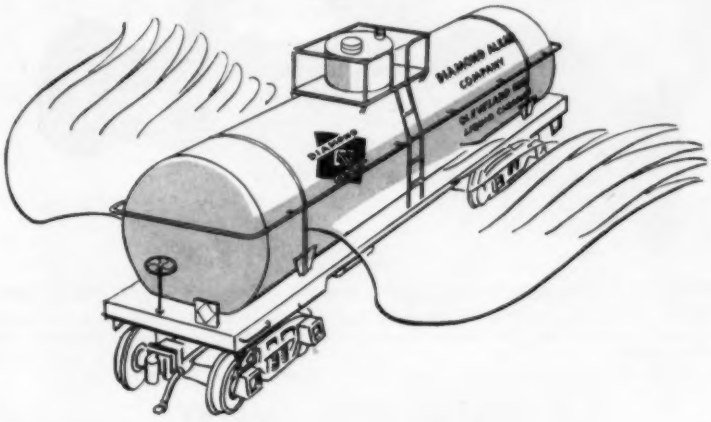
Mr. E. W. Prendergast, formerly branch manager at Atlanta, has been made regional manager of the Southeast territory. Joining the company in 1947, Mr. Prendergast served as industrial engineer with the Atlanta branch and became manager in 1952. In his new assignment he directs sales activities in Mississippi, Alabama, Georgia, Florida and sections of Arkansas, Tennessee, North Carolina and South Carolina.

In other changes, R. F. Sutton has been transferred from the Pittsburgh sales office to Pensacola, Florida, where he is serving as industrial engineer. Also assigned were industrial engineers F. J. Stevens, Jr., who will work out of the Lakeland, Fla., branch; H. C. Craig, transferring from Gray, Me., to Jacksonville as branch manager; and L. C. Estes, Atlanta branch.

Elsewhere in the South, G. W. Reed, Jr., has been named manager of Foxboro's New Orleans office; J. K. Younkins has been named manager at Charleston, W. Va. Joining the company as industrial engineers were W. H. Rhyne, T. A. Jones and M. N. Walker who will be assigned to the Chattanooga, Charlotte and Knoxville offices, respectively.

CHEMICALS YOU LIVE BY

Diamond Chlorine



want chlorine fast?

DIAMOND ALKALI SHIPS FROM 5 CONVENIENTLY LOCATED PLANTS

When you want chlorine or technical co-operation in a hurry, call DIAMOND ALKALI.

We are equipped to give you fast deliveries from five conveniently located plants; technical help from one of the world's greatest stores of chlorine know-how.

Call your nearest DIAMOND sales office or plant for regular or emergency shipments.

FREE! CHLORINE SAFE-HANDLING WALL CHART

DIAMOND ALKALI's years of know-how have been compressed into this chlorine safe-handling wall chart. Hang it where workers can read it. Copies free. Ask your DIAMOND sales office or write DIAMOND ALKALI COMPANY, 300 Union Commerce Building, Cleveland 14, Ohio.

DIAMOND ALKALI CHEMICALS

Diamond Chemicals

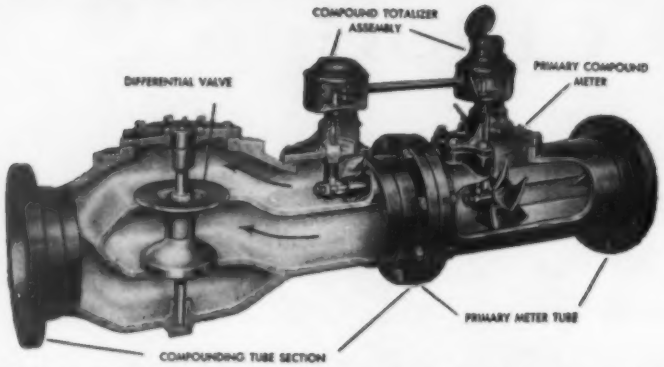
CHLORINE PLANTS: Edgewood, Md. — Houston, Texas — Muscle Shoals, Ala. Painesville, Ohio — Pine Bluff, Ark.

SALES OFFICES: Cleveland, Cincinnati, Chicago, Houston, Memphis, New York, Philadelphia, Pittsburgh, St. Louis

• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

SPARLING

WATER CONTROL EQUIPMENT



MAIN-LINE COMPOUND METERS — Simple — Rugged — Low Head Loss

Meets all the requirements for efficient water works service. Registration is continuous on a single totalizer for a flow range of 1 to 125. Negligible pressure loss and smooth valve action eliminate a sharp point of cut-over. Sizes: 6-inches to 36-inches. Information on this instrument and the complete line of Sparling Equipment is yours for the asking.

SPARLING METER COMPANY
INCORPORATED
Box 3277 • Los Angeles 54 • California

ATLANTA 3.....66 Luckie Street NW
BOSTON 8.....6 Beacon Street
CHICAGO 8.....1500 South Western Ave.
CINCINNATI 2.....626 Broadway
DALLAS 1.....505 No. Ervay St.
KANSAS CITY 6, MO.....6 E. Eleventh St.

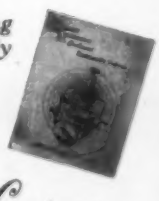
225 N. Temple City Blvd.....EL MONTE, CAL.
101 Park Avenue.....NEW YORK 17
85 Industrial St.....SAN FRANCISCO 24
1932 First Avenue.....SEATTLE 1
207 Queens Quay West.....TORONTO, CAN.
248 London Rd.....ROMFORD, ENGLAND

"Long after price is forgotten Quality is still remembered"

Golden-Anderson has never sacrificed quality just to "close the order." For over 50 years we have been designing and manufacturing valves that give dependable operation . . . that need little maintenance . . . that last a lifetime.

Let our experience and know-how work for you, too.

Technical bulletins, describing each of our valves in detail, gladly sent on request.



GOLDEN ANDERSON Valve Specialty Company
1246 RIDGE AVE., PITTSBURGH 33, PA.

Designers and Manufacturers of VALVES FOR AUTOMATION

Literature & Catalogs

Aluminum Gratings and Treads
420

The Washington Aluminum Co., Inc., Baltimore, Maryland, has available a folder on extruded **Aluminum Open Flooring Grating, Stair and Ladder Treads.**

This amply illustrated, 2-color folder discusses the uses of gratings and treads in power plants, water works, disposal plants, chemical and processing plants, and public projects and buildings. Drawings show construction details of the gratings and treads.

The last page of the folder describes the various fabrication facilities of the company including tanks, aeration trays, structures and special devices.

Service Saddle Catalog
421

Dresser Manufacturing Division, Bradford, Pennsylvania, has issued a new catalog on the **Style 91 Service Saddle.** Complete description and specifications of the saddle are included in this brochure.

According to the brochure the service saddles, for tapping asbestos cement, cast iron and steel pipe, are available in sizes 2 in. ID through 12 in. Among the features described are the flat straps and rolled threads. The flat straps give greater bearing surface on the pipe to prevent cutting or crushing. Rolled threads provide greater strength since no metal is cut away. Special Dresser rubber compound gaskets are cemented in place.

The saddles listed as available are heavily galvanized or with an economical special plastic dip. The plastic is non-toxic, does not "plate out" and has dielectric strength. Dresser Saddles have a wide range of fit which permits use interchangeably on asbestos-cement pipe and cast iron pipe in leading sizes.

Testing Water Meters
422

The Ford Meter Box Company, Inc., Wabash, Indiana, has just published a 40-page book on **Testing Water Meters.**

A veritable textbook, it is one of the most complete publications on the subject of testing water meters. Profusely illustrated with tables, photographs and drawings the book

also contains a list of printed articles on meter testing and maintenance that have appeared in the leading technical magazines in the field.

Some of the many subjects covered in detail in the book are: Why test water meters; Meter accuracy and unaccounted-for water; Principle and practice in water meter testing; The performance curve—what it is and what it shows; Public Service Commission Regulations concerning periodic testing of water meters; Equipment and layout of meter testing and maintenance shop; Testing large meters in the shop and in the field; Electric control in meter testing; Standard testing machines; and Testing tanks.

This book should prove a valuable addition to the library of any water works plant.

Beckman Instruments Extends Life Of Sewers

423

Beckman Instruments, Inc., Fullerton, California, has just published two **Application Data** sheets that describes how Beckman equipment is helping the life of the Cincinnati, Ohio, sewer system and scientifically detecting explosive sewer gases.

One data sheet tells how, by keeping a check on the pH of waste discharges through use of Beckman pH equipment mounted on a specially constructed trailer, the Cincinnati Sewage Disposal Section has obtained permanent and accurate records of waste discharges. Most important, the sewer system life has been extended.

The other data sheet explains that Cincinnati has also installed a Beckman DK-1 Ratio Recording Spectrophotometer to analyze samples from sewage flows for potentially dangerous concentrations of explosive gases. Operating in the Sewage Disposal Section's laboratory, accurate identifications of the gases have been simply made.

Self-Propelled Crane And Excavator

424

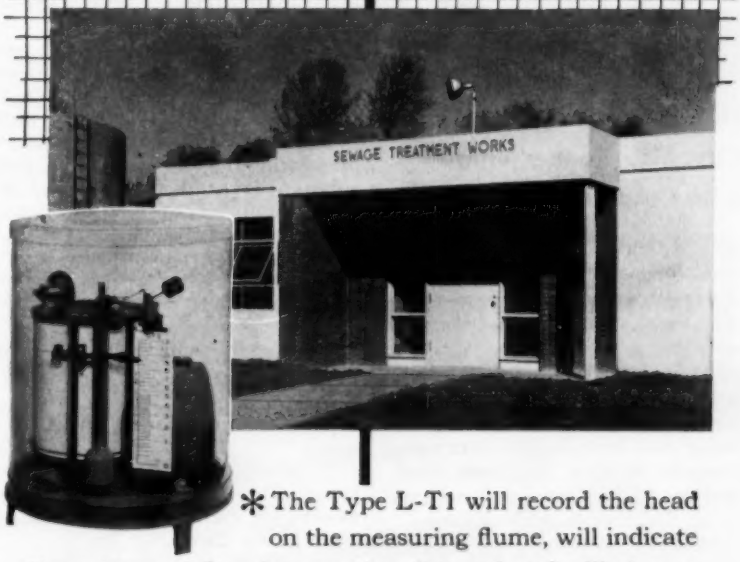
The Schield Bantam Co., Waverly, Iowa, has just released a bulletin describing the new **Self-Propelled Model CR-35 Power Crane and Excavator.**

The new bulletin contains detailed information concerning specifications, features, operating data, and capacities of the new unit. Ac-

(Continued on page 106A)

PROBLEM:
To obtain at minimum cost the essential information on flow required for efficient operation of a small sewage treatment plant.

SOLUTION:
Stevens Type L-T1 Recorder*



* The Type L-T1 will record the head on the measuring flume, will indicate the volume of flow for any time interval and will give an instantaneous reading of the rate of flow. The head record, made on convenient rectangular coordinates, is basic information for permanent record from which plant operators and State Sanitary Engineers can check flows and volumes. The volume reading from the totalizer dials and the rate of flow indicator are essential for intelligent operation. Readings can be made in any desired volume and flow units.

STEVENS DATA BOOK

...invaluable for your reference file
144 pages of technical data on recorder installations... plus a wealth of hydraulic tables and conversion tables. **Send $1.00 (No C.O.D.'s)**

CONSULT WITH STEVENS INSTRUMENTATION SPECIALISTS

LEUPOLD & STEVENS INSTRUMENTS, INC.
4445 N. E. GLISAN STREET • PORTLAND 13, OREGON
Foremost in Precision Hydraulic Instruments Since 1907

Another NEW Leopold Installation...

New 48 mgd Kansas City, Mo. plant equipped with Leopold Filter Bottoms

In addition to this recent installation, Leopold Compound Duplex Filter Bottoms are giving dependable, economical performance in well over 300 plants (with a daily capacity of more than 1¼ billion gallons). And the number of Leopold-equipped facilities is growing by leaps and bounds. For example, Leopold Bottoms have been specified for the five largest plants now being built in this country.

Whether you're modernizing your present plant or planning new construction, it will pay you to consider the many features offered only by Leopold Tile Filter Bottoms. They resist corrosion, are not subject to tuberculation, require only small sized gravel, are acid and alkali resistant, provide equal and uniform filtration, and will last indefinitely. Want more details? Write us today.

For TOP performance, use Leopold Bottoms

Leopold

F. B. LEOPOLD CO., INC.
2413 W. Carson Street
Pittsburgh 4, Pa.

COMPLETE WATER PURIFICATION AND SEWAGE PLANT EQUIPMENT!

cording to the bulletin some of the new features are: one-man operation, two-speed independent travel, no-shift forward-reverse travel design, and 19½-foot outside turning radius.

One full page is devoted to complete machine specifications and capacity ratings. Large charts show lifting capacities and digging ranges for crane, shovel, and back hoe attachments.

Ferri-Floc Handbook
425

Tennessee Corporation, Atlanta, Georgia, has just published a booklet on **Ferri-Floc**, a readily soluble ferric sulphate.

The foreword in the booklet explains the application of this material to water treatment, sewage treatment, sludge conditioning, and industrial wastes. An explanation of what Ferri-Floc is, feeding and solution data, advantages, uses in water supplies, and applications, also are included.

The last 15 pages of the booklet contain case histories of various water and sewage treatment plants using Ferri-Floc. Useful conversion tables and equivalents are also included.

Laboratory Emergency Chart
426

Fisher Scientific Company, Pittsburgh, Pa., has published a new edition of the **Fisher Laboratory Emergency Chart.**

The chart is a comprehensive, condensed, alphabetical compilation devised by Fisher safety specialists in consultation with the top safety experts from the U. S. Food and Drug Administration, American Public Health Association, U. S. Bureau of Mines, National Safety Council, and U. S. Public Health Service.

The chart, with an A-to-Z listing covering emergency treatments for specific poisons, as well as treatments for particular accidents and for corrosive chemical burns, represents all the new methods of treatment. It is 18 by 27 inches, with metal edges at top and bottom and a metal eyelet for hanging on the wall.

Medium And High Head Pumps
427

The C. H. Wheeler Manufacturing Company, Philadelphia, Pa., has just published an 8-page bulletin that describes and illustrates the **Wheeler-Economy Type M Pumps**

The Heart of fine WATER PURIFICATION

MECHANICAL EQUIPMENT BY ROBERTS FILTER MFG. CO. DARBY, PENNA.

SYSTEMS

Roberts Mechanical Equipment

ROBERTS FILTER Mfg. Co.
607 COLUMBIA AVE.
DARBY, PA.

***ACCURATE* pH, CHLORINE, FLUORIDE CONTROL *with* TAYLOR COMPARATORS**

REDUCES CHEMICAL WASTE

With Taylor Comparators, you can make fast, accurate analyses of pH and chlorine that enable you to determine the *exact* amounts of chemicals needed to control coagulation, chlorination, fluoridation and corrosion. Easy, on-the-spot colorimetric tests are made in minutes . . . just take sample, add reagent and move color standard slide across until colors match. Complete water analysis only a little more detailed with the Taylor Water Analyzer.

COLOR STANDARDS GUARANTEED
Taylor liquid color standards carry an unlimited guarantee against fading . . . no danger of mechanical inaccuracy.

SEE YOUR DEALER, or write direct for FREE HANDBOOK, "Modern pH and Chlorine Control". Gives theory and application of pH control. Illustrates and describes all Taylor sets.

W. A. TAYLOR AND CO.
7308 YORK RD. • BALTIMORE-4, MD

for medium- and high-head services.

The bulletin describes the advantages of high efficiency and low maintenance of the pumps. Cross-sections of design are shown for bottom suction and side suction types. Construction details are also included.

Chemical Treatment For Water Treatment

428

Graver Water Conditioning Co., New York, N. Y., has available a reprint on **The Selection of Chemical Treatment For Water Clarification.**

This informative article not only discusses the theoretical chemical problems of coagulation, but also goes into the actual physical consideration of the process. A major portion is devoted to a discussion of proper selection of the coagulant and the various coagulants available. There is also a useful table comparing the characteristics of these chemicals.

New Water Treatment Method

429

Graver Water Conditioning Co., New York, N. Y., has available a technical reprint that discusses the details of **Dealkalization, Its Application in Water Treatment.**

The reprint discusses the details of the process limitations and where it can be used. There are actual chemical equations to show exactly how the chemical reaction takes place and a description of the equipment needed.

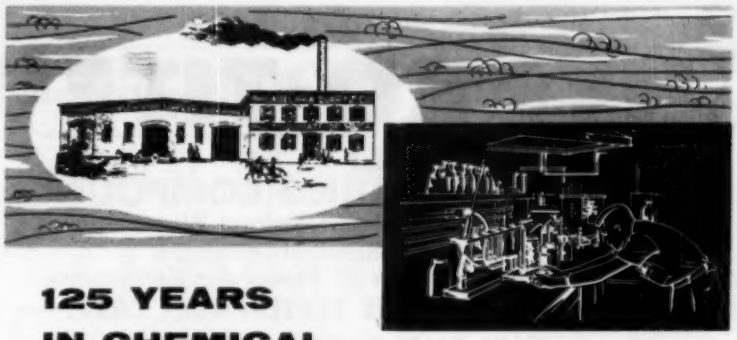
Conventional And High-Rate Water Treatment Plants Compared

430

Graver Water Conditioning Co., New York, N. Y., has available an informative technical article that presents an economic analysis of **Conventional And High-Rate Water Treatment Plants.**

According to the article, one of the first problems that arises in designing a municipal water treatment plant is whether to use high-rate or so-called conventional sedimentation equipment. Of major importance, as with so many other major items of equipment, is the economics of the two types of systems. The article uses actual case studies to demonstrate the various types of systems. Well illustrated with numerous photographs and

(Continued on page 108A)



125 YEARS IN CHEMICAL SERVICE . . . SOAP TO SILICATES

Soap, our first product in 1831, was followed 25 years later by silicate of soda used in soaps. Silicates became our exclusive interest in 1904.

PQ research in silicate properties through the years has uncovered and developed new uses; for example, raw and waste water treatment. We introduced several new methods of reacting silicates to produce activated silica sol used as coagulant aids.

Results of these studies have been published and are available to you.

Let us know how we can help you.

TRADEMARKS REG. U.S. PAT. OFF.

1831-1956 125th ANNIVERSARY

PQ SOLUBLE SILICATES / N-SOL PROCESSES

PHILADELPHIA QUARTZ COMPANY

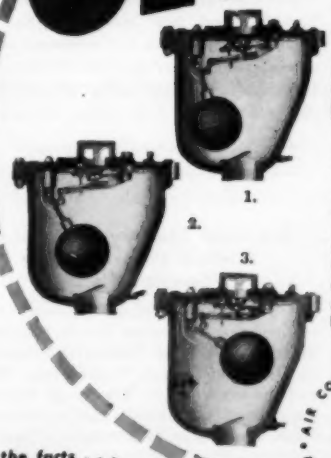
1137 Public Ledger Bldg., Philadelphia 6, Pa.

Nine Plants Distributors in 70 Cities

Crispin

UNIVERSAL AIR VALVES

Cut installation costs . . . provide complete air control



New Crispin 2" Universal Air Valves give positive, full-time, air control: (1) permit escape and entrance of air when line is being filled or emptied; (2) allow escape of accumulating air while line is in operation . . . and under pressure and (3) valve in closed position after air is exhausted. Cut-a-way illustrations show the operating positions. Simplified design, sturdy construction . . . preferred by water works engineers.

AIR CONTROL VALVES FOR OVER 40 YEARS

multiplex

MANUFACTURING COMPANY

BERWICK, PENNSYLVANIA

Get the facts . . . Write today for complete information on new Crispin Universal Air Valves and for your copy of the Crispin Air Valve Catalog.

• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

HYDRO-TITE

DEPENDABLE JOINTING COMPOUND

Seals Bell and Spigot Water Mains

Economical—Effective

Over 35 Years Of Dependable Performance

HYDRAULIC DEVELOPMENT CORP.

MAIN SALES OFFICE 50 CHURCH ST., N. Y. C.

General offices and works W. Medford Sta., Boston, Mass.

Servicing Water Holders All Types Elevated and Standpipes.

Specially designed materials that hold down corrosion.

IT'S THE APPLICATION THAT COUNTS

All guaranteed work

SPEELMON ELEVATED TANK SERVICE

Complete Painting & Repair Service

822 N. Court St. Rockford, Ill.

engineering drawings of the units and containing 10 different case histories, the bulletin also contains a graph that compares plant capacity and cost for both the high-rate and conventional plants.

Jiffy Joint Clay Pipe

431

Cannelton Sewer Pipe Co., Cannelton, Ind., has just released a new 4-page, illustrated bulletin describing its new **Plastic Jiffy Joint Clay Pipe.**

According to the bulletin, this factory-made joint stays true to dimensions regardless of temperature changes or pressure, and eliminates the problem of root penetration around the spigot end. Installation and jointing of Plastic Jiffy Joint is simple and fast. The bituminous joint inside the bell is simply coated with a solvent, and the spigot and bell ends are then pushed together by hand or with a pinch bar.

Condensation Return Units

432

The Aurora Pump Division of The New York Air Brake Company, Aurora, Illinois, has just released a new bulletin, describing its galvanized steel and cast iron **Receiver Condensation Return Units.**

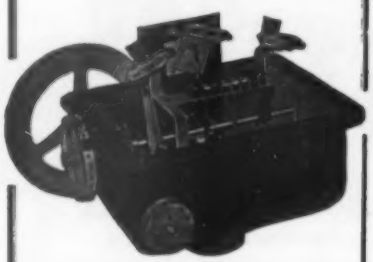
Selection tables and typical dimensions for both types of units are incorporated in the 2-color bulletin.

Wheel-Type Trenchliner

433

Parsons Company, Newton, Iowa, has just released a 16-page catalog that describes the hydraulic power for raising and lowering the digging wheel of the company's new **Wheel-Type Trenchliner.**

ROTO-TROL



RF-2

WITH ALTO-TROL

This 2-pump RF-2 Roto-Trol assures equal use and wear of both pumps. Each pump is operated on alternate starting cycles. The RF-2 operates both pumps together, when required. RF-2 installations give dependable service year after year, with the minimum of attention.

Write for full data

WATER LEVEL CONTROLS DIVISION

HEALY-RUFF COMPANY

783 HAMPDEN AVE. ST. PAUL 4, MINN.

POSITIONS AVAILABLE

SUPERINTENDENT $5500-$7000; CHEMIST $4500-$5500; MAINTENANCE SUPERVISOR (for mechanical and electrical equipment) $4500-$6000 and OPERATORS $3900-$4800 for new 18 MGD high-rate trickling filter sewage treatment plant to be placed in operation July 1, 1956. Positions available May 15, 1956. Vacation and sick leave benefits. Send resume of experience and minimum acceptable starting salary to City of Alexandria, Virginia, Sanitation Authority, 113 North St. Asaph Street, Alexandria, Virginia.

Graduate Sanitary Engineer or Chemist Experienced in Sanitary Field

For work in Consulting Engineers' Office on operation of Sewage Plants, Analysis of Water Sewage and Industrial Waste, and on Design of Sewage Plants, Water Works and Industrial Waste Treatment Plants.

Permanent position with paid vacation, sick leave, hospitalization, retirement plan and profit sharing plan.

Submit resume of references, education, experience and salary requirements. Albright & Friel Inc., Consulting Engineers, 3 Penn Center Plaza, Philadelphia 2, Pa.

SODIUM SILICOFLUORIDE

(Fluosilicate)

Inquiries Invited!

TENNESSEE TC CORPORATION

1028 CONNECTICUT AVE., N. W.

WASHINGTON 6, D. C.

MUNICIPAL SUPPLIES

W.S. DARLEY & CO.

Write Today for 100 Page Catalog

W. S. DARLEY & CO., Chicago 12

Photographs and drawings are used in the new catalog to describe the sensitive hydraulic power system developed for the Model 150 Trenchliner for digging wheel control. According to the catalog, the wheel moves up and down a vertical mast. A wheel-hoist ram raises and lowers the wheel to hold close grade tolerances at any digging depth. A separate mast-tilt ram holds the mast in a vertical position, and tilts it to bring the weight of the wheel forward for proper balance and clearance when traveling or loading on truck or trailer.

Tow-Bro Sludge Remover

434

Chain Belt Company, Milwaukee, Wis., has just published a bulletin that describes a new high efficiency sludge remover called the **Unitube Tow-Bro.**

This new booklet describes recent studies in sanitary hydraulic engineering at the University of Wisconsin. Here, the increased efficiency of Unitube's tapered header arm was proved conclusively. The studies showed that the operating advantages of the Unitube include clearer effluent, greater solids concentration with less reaeration over a wide range of flows.

Unitube, as pointed out in this booklet, enjoys a further advantage over conventional Tow-Bro Collectors, as it is priced 20 per cent below header and nozzle type collectors. Installation costs too, whether in new projects or existing tanks, are reduced because of Unitube's adaptability to any plant or condition—round or rectangular tanks.

Job Reports On Concrete Pipe

435

Price Brothers Company, Dayton, Ohio, has just released **Job Reports** on the installation of concrete pipe at Canton, Ohio, and one of Toledo's suburbs.

Sixteen-ft lengths of prestressed concrete cylinder pipe for water lines were laid down the streets of these cities while maintaining traffic, even in coldest weather. The reports tell how backhoes dug the trench and laid the pipe, how obstructions were cleared by using bevel adapters furnished by Price Brothers, and how easily the Canton line has been tapped since installation.

Industrial Waste Treatment

436

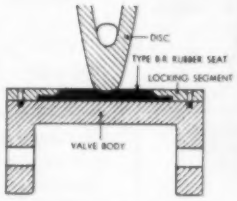
Milton Roy Company, Philadel-

(Continued on page 110A)

Be Sure of DROP-TIGHT CLOSURE

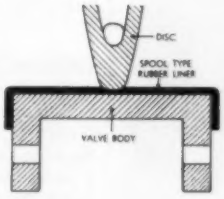
Valve with *Rubber Seat*

In this Rockwell butterfly valve the stainless steel edge of valve disc presses at 90° into thick, precision-molded Type B-R rubber seat, which is clamped in position by removable metal locking segments. Shaft of stainless steel (or other metal). Bearings—lifetime, heavy duty graphite-lubricated, sleeve type. No corrosion or contamination. Meets AWWA specifications for 25, 50 and 125 p.s.i. butterfly valves.



Valve *Rubber-Lined*

Valve with rubber spool liner—natural or synthetic, hard or soft—vulcanized and cemented to valve body. Preferred where fluid may affect cast iron or fabricated steel construction.



Other Advantages

- Minimum Restriction to Flow
- Self-Cleaning—No Debris-Collecting Pockets
- Compact • Lighter Weight
- Require Less Space
- Easier to Install

W. S. Rockwell Butterfly Valves are made in sizes from 4" to 144"; cast iron, fabricated steel or alloy construction. Furnished with any manual or automatic operator.

W. S. ROCKWELL COMPANY

ROCKWELL SINCE 1888 BUILT

BUTTERFLY VALVES • SLIDE VALVES • AUTOMATIC VALVES

2826 ELIOT STREET • FAIRFIELD, CONN.

Sales Representatives in Principal Cities

• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

St. Louis Turbidimeter

For measuring turbidity of water. Consists of cast aluminum housing, adjustable lamp . . . two vertical wells for holding two Nessler tubes.

This apparatus comes ready to plug into 115 volt line, comes fully equipped for normal operation.

WRITE:

Phipps & Bird, Inc.

P. O. Box 2V • Richmond 5, Va.

HAPMAN
Grit Conveyors

- Rugged Construction
- Low Power Requirements
- Neoprene Flights
- Adaptable to many needs

Write for further information

STUART CORPORATION
516 N. Charles St., Baltimore 1, Md.

phia, Pa., has just released a technical paper on the **Solution to Water and Waste Treatment Problems.**

Several practical systems for process and waste water treatment utilizing controlled volume pumps to meter chemicals and additives are described in this bound technical report. In the area of water treatment, such processes as coagulation, clarification, boiler water treating and oxygen scavenging by Hydrazine addition are discussed.

Paper mill white water recovery systems and waste treatment systems in plating mills, aircraft plants and metal fabricating plants, are also illustrated and analyzed.

Accelator Treating Plants

437

Infilco Inc., Tucson, Arizona, has just published a revised bulletin on the **Accelator Treating Plant.**

This 28-page, 4-color bulletin describes the historical development, operating features and distinguishing characteristics of the Accelator unit. A wide vista of applicability to water, sewage and industrial waste problems is presented.

Operating data from many of the 2000 successful installations prove the ability of the Accelator plant to handle liquids of high turbidities and variable flows by the exclusive operating principle of recirculation of large volumes of slurry with dynamic separation of solids.

Turbine-Type Pumps

438

Aurora Pump Division of The New York Air Brake Company, Aurora, Illinois, has just released a new, 8-page bulletin describing **APCO Master Turbine-Type Pumps.**

The new 2-color bulletin shows assembled and exploded views of turbine-type pumps to illustrate (1) how removable channel rings, spacer rings (where required) and impellers, which represent only a fraction of total pump cost, may be replaced to make the pump as good as new and (2) availability of pump with either conventional stuffing boxes or mechanical seals.

ENGINEERS

Leading Sewage Equipment Manufacturer needs civil and sanitary engineers for office sales engineering in long range permanent program leading to field sales work. Under 30 to locate in midwestern city. Send resume and photo. Box 1137, WATER & SEWAGE WKS., 185 N. Wabash Ave., Chicago, Illinois.

TO MAINTAIN THE HIGHEST WATER STANDARDS, GIVE IT THE modern TREATMENT

"More economical . . . most effective"... that's what engineers say about Modern equipment and supplies for swimming pools and reservoirs! Huge stocks, regional warehouses assure fast shipment. Over 100 items, including filters, anti-algae and other water-treatment chemicals, pool paint, pool equipment. Plus a staff of engineers for technical consultation. Write today for our FREE Catalog No. 15R.

For further information, see classified telephone directory for name of nearest distributor or write us.

modern GIVES YOU SO MUCH more...

modern SWIMMING POOL CO., INC.
One Holland Avenue, White Plains, N. Y.
Manufacturers of Swimming Pool Supplies Since 1935

SterElators by Everson

Chlorine Gas Control Equipment
Visible Flow Indication
Vacuum Solution Feed

for
Water Works
•
Sewage Treatment
•
Industrial Plants
•
Swimming Pools
•
Easy to Install
•
Easy to Operate
•
Low Maintenance Cost
•

Everson STERELATORS can be furnished for fully automatic, semi-automatic and manual control.

Write for STERELATOR Bulletins

EVERSON MFG. CORP.
233 W. Huron St., Chicago 10, Ill.

Consulting Engineers

SPECIALIZING IN THE FIELD OF

WATER & SEWAGE WORKS

ALBRIGHT & FRIEL INC.

Consulting Engineers

Water, Sewage, Industrial Wastes and Incineration Problems—City Planning, Highways, Bridges and Airports—Dams, Flood Control, Industrial Buildings—Investigations, Reports, Appraisals and Rates—Laboratory for Chemical & Bacteriological Analyses—Complete Service on Design and Supervision of Construction.

Three Penn Center Plaza
Philadelphia 2, Pa.

Alvord, Burdick & Howson

Engineers

Water Works, Water Purification, Flood Relief, Sewerage, Sewage Disposal, Drainage, Appraisals, Power Generation

20 N. Wacker Drive. Chicago 6, Ill.

JOHN J. BAFFA

Consulting Engineer

Water Supply and Treatment
Sewerage and Sewage Treatment

75 West Street New York 6, N. Y.

MICHAEL BAKER, JR., INC.

The Baker Engineers

Civil Engineers, Planners, and Surveyors

Airports, Highways, Sewage Disposal Systems, Water Works Design and Operation—City Planning—Municipal Engineering—All types of Surveys

Home Office: Rochester, Pa.

Branch Offices:
Jackson, Miss. Harrisburg, Pa.

W. H. & L. D. BETZ

CONSULTING ENGINEERS

INDUSTRIAL WASTE
INDUSTRIAL WATER

ANALYSIS DESIGN
INVESTIGATIONS OPERATION

Gillingham & Worth Sts.
Philadelphia 24, Pa.

BLACK & VEATCH

Consulting Engineers

Water — Sewage — Electricity
Industry

Reports, Design, Supervision of Construction, Investigations, Valuation and Rates

4706 Broadway, Kansas City 2, Missouri

BOGERT AND CHILDS

CONSULTING ENGINEERS

Clinton L. Bogert — Fred S. Childs
Ivan L. Bogert — Donald M. Ditmars
Robert A. Lincoln — Charles A. Manganaro
William Martin

Water & Sewage Works • Refuse Disposal • Drainage • Flood Control • Highways and Bridges • Airfields

145 East 32nd Street, New York 16, N. Y.

BOYLE ENGINEERING

Consulting Engineers

Water — Sewers — Streets
Structures — Surveys
Reports — Special Districts

331 Spurgeon Bldg. Santa Ana, Calif.
3913 Ohio, Rm. 200 San Diego 4, Calif.

Bowe, Albertson & Associates

Engineers

Water and Sewage Works—Industrial Wastes—Refuse Disposal—Municipal Projects—Industrial Buildings—Reports—Plans—Specifications—Supervision of Construction and Operation—Valuations—Laboratory Service

75 West Street New York 6, New York

Buck, Seifert and Jost

Consulting Engineers

Water Supply, Sewage Disposal, Hydraulic Developments, Reports, Investigations, Valuations, Rates, Design Construction Operation Management, Chemical and Biological Laboratories

112 East 19th St. New York

BURGESS & NIPLE

Civil and Sanitary Engineers

Water Supply and Purification
Sewerage and Sewage Treatment
Appraisals, Reports, Valuations

2015 West Fifth Avenue
Columbus 12, Ohio

BURNS & McDONNELL

Consulting and Designing Engineers

Kansas City, Mo.
P.O. Box 7088

Cleveland, Ohio
1404 E. 9th St.

Camp, Dresser & McKee

Consulting Engineers

6 Beacon Street, Boston 8, Mass.

Water Works and Water Treatment; Sewerage and Sewage Treatment; Municipal and Industrial Wastes; Investigations and Reports; Design and Supervision; Research and Development; Flood Control.

CAPITOL ENGINEERING CORPORATION

Engineers—Constructors—Management

SEWAGE SYSTEMS — WATER WORKS
Designs and Surveys — Roads and Streets
Planning — Airports
Bridges — Dams

Executive Offices
DILLSBURG, PENNSYLVANIA

The Chester Engineers

Water Supply and Purification—Sewage and Industrial Waste Treatment—Power Plants—Incineration—Gas Systems—Valuations — Rates — Management — Laboratory—City Planning

210 E. Park Way,
Pittsburgh 12, Penna.

Chas. W. Cole & Son

Engineers — Architects

Sewerage, Water Supply, Bridges, Highways, Toll Roads, Industrial, Municipal and Commercial Buildings

220 W. LaSalle Ave., South Bend, Indiana
Central 4-0127

CONSOER, TOWNSEND & ASSOCIATES

Water Supply, Sewerage, Flood Control & Drainage, Bridges, Express Highways Paving, Power Plants, Appraisals, Reports, Traffic Studies, Airports, Gas & Electric Transmission Lines.

351 East Ohio St., Chicago 11, Illinois

COTTON, PIERCE, STREANDER, INC.

Associated Engineering Consultants

132 Nassau St., New York, N. Y.
6 Beacon St., Boston, Mass.
55 Caroline Rd., Gowanda, N. Y.
2718 Garfield St., Hollywood, Fla.

Water Supply Treatment, Distribution, Sewerage, Sewage Treatment, Refuse Disposal, Trade Wastes, Power Plants, Reports, Plans, Supervision.

DE LEUW, CATHER & COMPANY

Water Supply — Sewerage
Railroads — Highways
Grade Separations—Bridges—Subways
Local Transportation

Investigations — Reports — Appraisals
Plans and Supervision of Construction

150 North Wacker Drive Chicago
79 McAllister Street San Francisco 2, Calif.

FAY, SPOFFORD & THORNDIKE

Engineers

John Ayer — Ralph W. Horne
Elon A. Bowman — William L. Nyman
Carroll A. Farwell — Frank L. Lincoln
Howard J. Williams

Water Supply and Distribution—Drainage
Sewerage and Sewage Treatment
Airports—Bridges—Turnpikes
Port and Terminal Works — Industrial Bldgs.
Investigations, Reports, Designs, Valuations
Supervision of Construction

BOSTON NEW YORK

Finkbeiner, Pettis & Strout

Carleton S. Finkbeiner, C. E. Pettis, Harold K. Strout

Consulting Engineers

Reports Designs Supervision

Water Supply, Water Treatment, Sewerage, Sewage Treatment, Wastes Treatment, Valuations & Appraisals.

518 Jefferson Avenue Toledo 4, Ohio

Additional Engineers Cards on Next Page

F. R. FRIEDEWALD
CONSULTING ENGINEER
Waterworks ★ Sewage ★ Gas Supply and Distribution ★ Drainage ★ Street Improvements
Estimates ★ Reports ★ Surveys
311 SOUTH FIRST ST., BELLEVILLE, ILLINOIS
Phone: Belleville 2225

Hayden, Harding & Buchanan, Inc.
Consulting Engineers
John L. Hayden
John H. Harding — Oscar J. Campia
Waterworks, Sewerage, Civil, Mechanical, Electrical, Structural
810 Park Square Building, Boston, Mass.

Morris Knowles, Inc.
Engineers
Water Supply and Purification, Sewerage and Sewage Disposal, Valuations, Laboratory, City Planning
1312 Park Building, Pittsburgh, Pa.

Freese & Nichols
FORT WORTH, TEXAS
Freese, Nichols & Turner
HOUSTON, TEXAS
Industrial and Municipal Engineering—Water Supply and Purification—Sewerage and Industrial Waste Treatment—Highways and Structures—Dams—Drainage Works—Airports—Investigations—Valuation—Design and Supervision

HAZEN AND SAWYER
Engineers
Richard Hazen — Alfred W. Sawyer
Municipal and Industrial Water Supply Purification and Distribution
Sewage Works and Waste Disposal
Investigations, Design, Supervision of Construction and Operation
122 East 42nd Street — New York 17, N.Y.

LANNING
Sanitary Engineering Co., Inc.
Consulting Engineers
Professional Building
1100 South Broad Street
Trenton — New Jersey

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
Engineers
HARRISBURG, PA.
Pittsburgh, Pa. — Daytona Beach, Fla.
Philadelphia, Pa. — Pleasantville, N. J.
Water Works, Sewage, Industrial Wastes and Garbage Disposal—Roads, Airports, Bridges, Flood Control, Traffic & Parking, Appraisals, Investigations & Reports.

HENNINGSON, DURHAM & RICHARDSON
Consulting Engineers since 1917 for more than 700 cities and towns.
Water Works, Light and Power, Sewers, Sewage Treatment, Reports, Flood Control, Appraisals, Drainage, Paving.
2962 Harney St., Omaha 2, Nebraska

LOCKWOOD GREENE ENGINEERS, INC.
Architects - Engineers
Montgomery Building
SPARTANBURG, S. C.
Water Supply—Power Plants
Sewage Disposal—Valuations & Appraisals
Industrial Waste — Industrial Plant Design

GILBERT ASSOCIATES, INC.
Engineers and Consultants
Water Supply and Purification
Sewage and Industrial Waste Treatment
Chemical Laboratory Service
Investigations and Reports
New York — Reading, Pa. — Washington
Houston — Philadelphia

JAMES and BAXTER Associates, Inc.
Architects and Engineers
A complete professional service
Architectural, Civil, Industrial, Municipal
2962-64 Coral Way, Miami 34, FLORIDA

WM. S. LOZIER CO.
Sewerage, Sewage Disposal, Water Supply, Water Purification
Refuse Disposal
Consulting Engineers
10 Gibbs Street — Rochester 4, N. Y.

GLACE AND GLACE
Consulting Sanitary Engineers
WATER SUPPLY AND PURIFICATION
SEWERAGE AND SEWAGE TREATMENT
Design, Construction and Supervision of Operation
1001 North Front St. — Harrisburg, Pa.

The Jennings-Lawrence Co.
Civil & Municipal Engineers
Consultants
Water Supply, Treatment & Distribution
Sewers & Sewage Treatment
Reports—Design—Construction
1392 King Ave. — Columbus 12, Ohio

Metcalf & Eddy
Engineers
Water, Sewage, Drainage, Refuse and Industrial Waste Problems
Airports — Valuations
Laboratory
Statler Building, Boston 16

GREELEY AND HANSEN
Engineers
Samuel A. Greeley — Paul Hansen (1920-1944)
Paul E. Langdon — Kenneth V. Hill
Thomas M. Niles — Samuel M. Clarke
Water Supply, Water Purification
Sewerage, Sewage Treatment
Flood Control, Drainage, Refuse Disposal
220 S. State Street, Chicago 4

Jones, Henry & Williams
Consulting Sanitary Engineers
Water Works
Sewerage & Treatment
Waste Disposal
821 Security Bldg. — Toledo 4, Ohio

NUSSBAUMER, CLARKE & VELZY, INC.
Newell L. Nussbaumer—Irving Clarke—Charles R. Velzy
Water Supply and Treatment
Sewerage & Sewage Disposal
Garbage Incineration
Municipal Planning
500 Fifth Avenue, New York 36, N. Y.
327 Franklin St. — Buffalo, N. Y.

HASKINS, RIDDLE & SHARP
Consulting Engineers
Water—Sewage & Industrial Wastes—Hydraulics
Reports, Design, Supervision of Construction
Appraisals, Valuations, Rate Studies
1009 Baltimore Ave. Kansas City 5, Mo.

R. L. KENAN & ASSOCIATES
CONSULTING ENGINEERS
Water Works, Flood Control, Sewerage, Sewage Disposal, Airports, Harbor and Waterfront Improvements.
MONTGOMERY, ALA. — PENSACOLA, FLA.

PARSONS, BRINCKERHOFF HALL & MACDONALD
G. Gale Dixon, Associate
Wellington Donaldson, Staff Consultant
Water, Sewage, Drainage and Industrial Waste Problems.
Structures — Power — Transportation
51 Broadway — New York 6, N.Y.

HAVENS AND EMERSON
W. L. HAVENS — A. A. BURGER
J. W. AVERY — H. H. MOSELEY
F. S. PALOSKAY — K. S. ORDWAY
P. C. TOLLES, CONSULTANT
CONSULTING ENGINEERS
WATER, SEWERAGE, GARBAGE, INDUSTRIAL WASTES VALUATIONS—LABORATORIES
LEADER BLDG. — WOOLWORTH BLDG.
CLEVELAND 14, O. — NEW YORK 7, N.Y.

Engineering Office of
CLYDE C. KENNEDY
SANITARY ENGINEERING
SAN FRANCISCO

MALCOLM PIRNIE ENGINEERS
Malcolm Pirnie — Ernest W. Whitlock
Robert D. Mitchell — Carl A. Arenander
Malcolm Pirnie, Jr.
MUNICIPAL AND INDUSTRIAL
Water Supply - Water Treatment
Sewage and Waste Treatment
Drainage - Sewerage - Refuse Disposal
25 West 43rd St. — New York 36, N. Y.

Additional Engineers Cards on Next Page

THE PITOMETER ASSOCIATES, INC.
Engineers
Water Waste Surveys
Trunk Main Surveys
Water Distribution Studies
Water Measurements & Special Hydraulic Investigations
New York. 50 Church Street

J. E. SIRRINE Company
Engineers
Water Supply & Purification
Sewage & Industrial Waste Disposal
Stream Pollution Reports
Utilities, Analyses
Greenville South Carolina

Wertz Engineering Co., Inc.
Consultants, Designers & Constructors
Water Supply & Purification
Sewage & Industrial Waste Treatment
Stream Pollution Studies
Chemical & Bact. Laboratory Service.
441 North 2nd St. Reading, Pa.

LEE T. PURCELL
Consulting Engineers
Water Supply & Purification; Sewerage & Sewage Disposal; Industrial Wastes; Investigations & Reports; Design; Supervision of Construction & Operation
Analytical Laboratories
36 De Grasse Street Paterson 1, N.J.

Benjamin L. Smith & Associates
Engineers
Investigations — Reports
Designs — Supervision — Valuations
Municipal Engineering and Public Utilities
11 North Pearl Street
Albany 7, New York

WESTON, ECKENFELDER AND ASSOCIATES
Consultants
Engineers • Biologists • Chemists
Industrial Wastes
Stream Pollution - Air Pollution
Water - Sewage
Surveys - Research - Development - Process Engineering - Operation Supervision - Analyses Evaluations and Reports
Newtown Square, Pa. Leonia, N. J.

Thomas M. Riddick
Consulting Engineer and Chemist
Municipal and Industrial Water Purification Sewage Treatment. Plant Supervision, Stream Pollution Investigations, Chemical and Bacteriological Analyses.
169 East 149th Street
New York 55, N. Y.

STANLEY ENGINEERING COMPANY
Consulting Engineers
327 S. LaSalle St. Hershey Building
Chicago 4, Ill. Muscatine, Iowa

Weston & Sampson
Water Supply, Water Purification, Sewerage, Sewage and Industrial Waste Treatment, Corrosion Control, Laboratory Service
Supervision, Valuations
14 Beacon St. Boston, Mass.

ROBERT AND COMPANY ASSOCIATES
Engineering Division
ATLANTA

Alden E. Stilson & Associates
Limited
Consulting Engineers
Water Supply—Sewage—Waste Disposal
Bridges—Highways—Industrial Buildings
Studies—Surveys—Reports
245 North High St. Columbus, Ohio

Whitman & Howard
Engineers (Est. 1869)
Water Supply, Water Purification, Sewerage, Sewage Disposal, Water Front Improvements and all Municipal and Industrial Development Problems, Investigations, Reports, Designs, Supervision, Valuations.
89 Broad St., Boston, Mass.

RUSSELL AND AXON
Consulting Engineers
Civil—Sanitary—Structural
Industrial—Electrical
Rate Investigations
408 Olive St., St. Louis 2, Mo.
Municipal Airport, Daytona Beach, Fla.

UHLMANN & ASSOCIATES
PAUL A. UHLMANN H. E. BONHAM
CARL E. KUCK NYE GRANT
Consulting Engineers
Water Supply and Purification
Sewage and Industrial Waste Treatment
4954-58 N. High St. Columbus 14, O.

WHITMAN, REQUARDT & ASSOCIATES
Engineers — Consultants
Civil—Sanitary—Structural—Mechanical—Electrical
Reports, Plans, Supervision, Appraisals
1304 St. Paul Street
Baltimore 2, Maryland

WANTED

Man who is familiar with the general field of water treatment to drive a mobile display and service unit in assigned sections of the U. S. contacting engineers, municipalities, contractors and others.

The man selected will be paid a salary plus all travel expenses. There will also be a liberal vacation arrangement. Please forward a complete résumé including an indication of your salary requirement to

Precision Chemical Pump Corp.
1396 Main Street
Waltham 54, Massachusetts

WANTED

Sanitary engineers for positions with state and local health departments. Openings for beginning and experienced engineers with college degrees. Write for announcement showing minimum qualifications, salary ranges and other information to Florida Merit System, 307 W. V. Knott Building, Tallahassee, Florida.

FOR SALE

Reconditioned Black Pipe

8⅝" O.D. .322 wall 28.55 lbs. per foot—100,000 feet.

12¾" O.D. .375 wall 49.56 lbs. per foot—35,000 feet.

20-foot random lengths lapweld. Beveled ends ready for installation in gas, water, oil lines or structural purposes. Complete inventories of all sizes black and galvanized pipe also available.

Write—Wire—Phone

Sonken-Galamba Corporation
2nd and Riverview (X-160)
Kansas City 18, Kansas
ATwater 9305

Overlooking the Fenway
Boston, *Mass.*
Attractive, comfortable, homelike rooms, suites and kitchenettes—near Kenmore Square and Boston University. Modern, fireproof building. *from* $6 double
FAMILY PLAN
Special rates for permanent guests.
Hotel **CANTERBURY**
14 Charlesgate West, Boston, Mass.

INDEX TO ADVERTISERS

A

*A.C.F. Industries.....Inside Front Cover
*Alabama Pipe Co.....100A
Albright & Friel, Inc.....111A
Alvord, Burdick & Howson.....111A
American Hard Rubber Co.....82A
Aurora Pump Div.....82A

B

Badger Meter Mfg. Co.....23A
Baffa, John J.....111A
Baker, Jr., Michael.....111A
Betz, W. H. & L. D.....111A
*B-I-F Industries, Inc.
Inside Back Cover, 91A-98A
Black & Veatch.....111A
Bogert and Childs.....111A
Bowe, Albertson & Associates.....111A
Boyle Engineering.....111A
Buck, Seifert and Jost.....111A
*Builders-Providence, Inc.
Inside Back Cover, 91A-98A
Burgess & Niple.....111A
Burns & McDonnell.....111A

C

Camp, Dresser & McKee.....111A
Capitol Engineering Corporation.....111A
Cast Iron Pipe Research Ass'n.....10A-11A
Cement-Gun Co.....102A
Centriline Corp.....96A
Chapman Valve Mfg. Co.....30A
Chester Engineers, The.....111A
*Chicago Bridge & Iron Co.....18A
*Chicago Pump Company.....75A
Cleveland Trencher Co.....13A
Clow & Sons, James B.....4A
Cole & Son, Chas. W.....111A
Consoer, Townsend & Associates.....111A
Cotton, Pierce, Streander, Inc.....111A
Crane Co.....22A

D

Darley Co., W. S.....108A
DeLaval Steam Turbine Co.....24A
DeLeuw, Cather & Company.....111A
DeZurik Shower Co.....102A
Diamond Alkali Co.....103A

E

Eddy Valve Co.....32A
Everson Mfg. Corp.....110A

F

Fay, Spofford & Thorndike.....111A
Fine Organics, Inc.....101A
Finkbeiner, Pettis & Strout.....111A
*Fischer & Porter Co.....21A
Flexible, Inc.....91A
Freese, Nichols & Turner.....112A
Friedewald, F. R.....112A

G

Gannett Fleming Corddry
and Carpenter, Inc.....112A
Gilbert Associates, Inc.....112A
Glace & Glace.....112A
Golden Anderson Specialty
Valve Co.....104A
Greeley & Hansen.....112A
Grinnell Co., Inc.....77A

H

Hammarlund Mfg. Co.....97A
Hamilton Kent Mfg. Co.....76A
Haskins, Riddle & Sharp.....112A
Havens & Emerson.....112A
Hayden, Harding & Buchanan.....112A
Hazen & Sawyer.....112A
Healy-Ruff Company.....108A
Henningson, Durham & Richardson.....112A
Hersey Manufacturing Company.....17A
Homestead Valve Mfg. Co.....26A
Hotel Canterbury.....113A
Hydraulic Development Corp.....108A

I

Iowa Valve Co.....100A
Infilco Inc.....Back Cover

J

James & Baxter Associates, Inc.....112A
*Jeffrey Mfg. Co.....29A
Jennings-Lawrence Co., The.....112A
Jones, Henry & Williams.....112A

K

Kenan & Associates, R. L.....112A
Kennedy, Clyde C.....112A
Knowles, Inc., Morris.....112A
*Komeline-Sanderson Engr. Corp.....31A

L

Lakeside Engr. Corp.....82A
Layne & Bowler, Inc.....85A
*Leopold & Co., Inc., F. B.....106A
Leupold & Stevens Instr. Co., Inc.....105A
*Link-Belt Company.....9A
Lockwood Greene Engrs., Inc.....112A
Lozier Co., Wm. C.....112A

M

*M & H Valve & Fittings Co.....90A
Metcalf & Eddy.....112A
Minneapolis-Honeywell Reg. Co.....20A
Mortell Co., J. W.....78A
Modern Swimming Pool Co.....110A
*Mueller Company.....19A
Multiplex Mfg. Co.....107A

N

*National Clay Pipe Mfrs., Inc.....3A
*Neptune Meter Company.....34A
Nussbaumer, Clarke & Velzy, Inc.....112A

O

*Olin Mathieson Chem. Corp.....33A
Oliver Corp.....7A
*Omega Machine Co.
Inside Back Cover, 91A-98A

P

*Pacific Flush Tank Company.....6A
Parsons, Brickerhoff, Hall &
MacDonald.....112A
Peerless Pump Div.....8A
Penna. Salt Mfg. Co.....81A
Phelps Dodge Refin. Corp.....92A
*Philadelphia Quartz Co.....107A
*Phipps & Bird, Inc.....110A
Pirnie Engineers, Malcolm.....112A
Pitometer Associates, Inc., The.....113A
*Pittsburgh-Des Moines Steel Co.....16A
Portland Cement Ass'n.....12A
Presstite Engr. Co.....99A
Preload Corp.....84A
Purcell, Lee T.....113A

R

Riddick, Thomas M.....113A
Robert and Company Associates.....113A
*Roberts Filter Co.....106A
Rockwell Co., W. S.....109A
Russell and Axon.....113A

S

*Simplex Valve & Meter Co.....28A
Sirrine Company, J. E.....113A
Smith & Associates, Benjamin L.....113A
Smith Co., S. Morgan.....25A
Smith Co., A. P.....83A
Sparling Meter Co., Inc.....104A
Speelmon Elevated Tank.....108A
Standard Dry Wall Products Co.....95A
Stanley Engineering Company.....113A
Stilson & Associates, Alden E.....113A
Stuart Corp.....110A

T

*Tennessee Corp.....108A
Taylor & Co., W. S.....106A

U

Uhlman & Associates.....113A
U. S. Electrical Motors.....80A
*U. S. Pipe & Foundry Co.....15A
U. S. Rubber.....89A

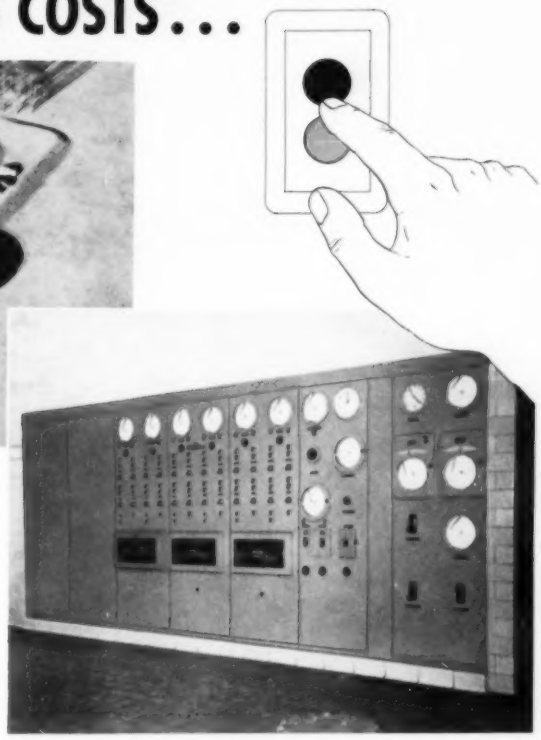
W

*Walker Process Equip Co., Inc.....14A
Wertz Engineering Co., Inc.....113A
*Western Machy. Co.....79A
Weston, Eckenfelder, Inc.....113A
Weston & Sampson.....113A
Wheeler Economy Pumps, Inc.....94A
White Diesel Eng. Div.....27A
Whitman & Howard.....113A
Whitman, Requardt & Associates.....113A
Wood Co., R. D.....86A-87A

*Advertisers represented in the Annual 1955 Reference and Data Edition with Catalog specifications copy. Please refer to that issue for additional information concerning their products or equipment.

HOW BUILDERS *AUTO-CENTRAL* FILTER CONTROL REDUCES COSTS...

▲ Aldrich Purification Units and Filters at Alexandria plant of American Water Works Service Company.



Central control panel in pump and chemical feed building. From this board, the filter effluent and backwash rates are remotely controlled by means of Builders Auto-Central Control. ▶

The same type of automatic time-sequence operation which has won such wide acceptance for automatic home washing machines now comes to the modern water works. Here is one of the first installations of Builders Auto-Central (automatic-centralized) filter Control, proven by over three years of successful operation at the Alexandria Water Company in Alexandria, Va.

Builders Auto-Central Control has many advantages: It saves time — relieves plant personnel for other duties. It eliminates supervisory headaches. It insures accurate backwash rates, proper washing times, and helps to maintain maximum filter efficiency. It reduces construction costs by eliminating the need for shelter over conventional operating tables.

Here's how Builders Auto-Central Control backwashes a filter: A Builders Loss-of-Head Gauge signals the need for filter backwashing. The pumping station operator (there's only one per shift!) pushes a button which starts the backwash cycle for the proper filter. The Sequence Controller and Pneumatic-Hydraulic Valve Positioners then complete the washing cycle step by step, and return the filter to normal operation TOTALLY UNATTENDED.

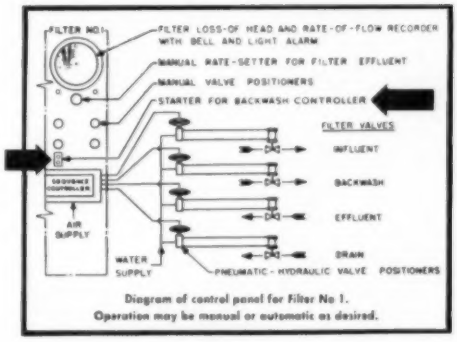


Diagram of control panel for Filter No 1.
Operation may be manual or automatic as desired.

Auto-Central Filter Control is another example of Builders' pioneering in the water works field. For complete details on this or other types of Builders Water Works Equipment, write Builders-Providence, Inc. (Division of B-I-F Industries, Inc.), 350 Harris Ave., Providence 1, R. I.

B-I-F

B-I-F INDUSTRIES

PROVIDENCE, RHODE ISLAND

BUILDERS IRON FOUNDRY • PROPORTIONEERS, INC.
BUILDERS-PROVIDENCE, INC. • OMEGA MACHINE CO.

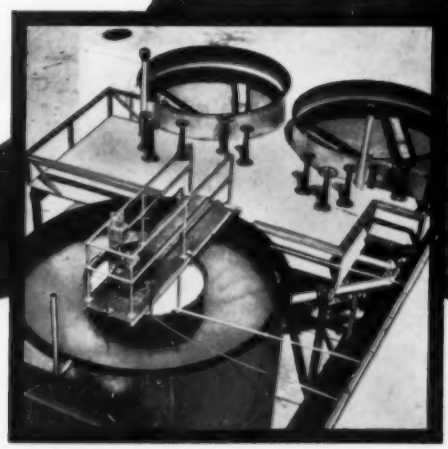
B-I-F METERS FEEDERS CONTROLS

You can have...

15 to 350 gpm high quality water at low cost!

...with

"ACCELAPAK" Treating Plant
(trademark)



Are you looking for a clarification or softening plant which can be installed at comparatively low cost and will produce high-quality water with very little operation attention? The "ACCELAPAK" treating plant, another example of INFILCO leadership in water-treating equipment, is your answer. It is specifically designed for small communities, subdivisions, industrial plants, resorts and estates.

This dependable, efficient plant includes an ACCELATOR® clarifier or softener, slurry feeder, coagulant feeder, rate of flow controller, gravity or pressure filter, and other feeders, pumps and purifiers as needed.

It can easily be incorporated in engineering for new plants or adapted to existing structures.

INFILCO KNOWS HOW . . . . . to help solve your problem.

Over 2000 "ACCELATOR" treating plants are now in operation and reports are universally enthusiastic—for efficiency, dependability and economy. If you are tolerating inferior water or makeshift methods of an obsolete plant investigate this outstanding unit. Write today for Bulletin No. 1870-WS-07.

Inquiries are also invited on all other water and waste treating problems including coagulation, precipitation, sedimentation, filtration, flotation, aeration, ion exchange and biological processes.

INFILCO INC.
Tucson, Arizona
The ONE company offering equipment for ALL types of water and waste treatment
FIELD OFFICES IN PRINCIPAL CITIES IN NORTH AMERICA

INFILCO

5607